MACHINE DESIGN

THE PROFESSIONAL JOURNAL OF CHIEF ENGINEERS AND DESIGNERS

Volume 11 — MAY 1939 — Number 5

Contents

Page

Hydraulics Cannot Be Denied!—Part II 23
By Hans Ernst and Albert H. Dall

Scanning the Field for Ideas 28

That Question of Cost! 31
By R. S. Elberty

Selecting Seals and Packings 34
Part I—Unit Seals
By George Z. Griswold

Graphs Aid in Governor Design 39
By R. C. Binder

Speed of Paper Machinery Increased by Vacuum Process 41

Design Features in New Machines 44

World's Fairs, Not War, May Initiate Turning Point in Business (Editorial) 46

Professional Viewpoints 47
Topics 48
Men of Machines 50
Assets to a Bookcase 54
Noteworthy Patents 56
New Materials and Parts 62
Calendar of Meetings 74
Manufacturers' Publications 76
Business Announcements 80
New Machines 82

For Itemized Table of Contents See Page 7

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MACHINE DESIGN is published on the seventh of each month. Subscription rates: United States and possessions, Canada, Cuba, and Mexico, two years $5; one year $3. Single copies 35 cents. Great Britain and other European countries, one year $5. Copyright 1939 by The Penton Publishing Co. Acceptance under act of June 5, 1934, authorized July 20, 1934.

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● Such is the amazing story of precision work on 92 New Departure Ball Bearings in this special Bradford Machine Tool, used for drilling 18 smoke holes in automobile pistons—at the rate of 600 pistons per hour!

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2761

Itemized Index

CLASSIFIED FOR CONVENIENCE WHEN STUDYING SPECIFIC DESIGN PROBLEMS

EDIT., EDITORIAL PAGES; ADV., ADVERTISING PAGES; R, RIGHT-HAND COLUMN; L, LEFT-HAND COLUMN

Design Calculations:

Springs, disk, calculations of ratified, Edit. 47

Design Problems:

Atomizers, in oil burners, operating without carbonization, Edit. 29
Drives, electrical, cost may influence choice of, Edit. 31, 32, 33
Fluid volume, hydraulic, controlling by ball valve, Edit. 56R
Governors, graphs aid design of, Edit. 39, 40
Grinding mill, controlling feed of by sound level, Edit. 29R, 30L
Hydraulics, use of, in modern machines, Edit. 23, 24, 25, 26, 27
Motors, using compressor bearings in, Edit. 30L
Paper machinery, speed of increased by vacuum process, Edit. 41, 42, 43
Pumps, utilizing helical screw to build up pressure in, Edit. 60R
Seals and packings, selecting, Edit. 34, 35, 36, 37, 38
Speeds, in machines, changed automatically with hydraulics, Edit. 28
Speeds of motors, controlling pneumatically, Edit. 58R

Finishes:

Enamel, low-bake, Edit. 64R

Materials:

Alloys (copper), Edit. 30R; Adv. 18
Alloys (magnesium), Adv. 11
Alloys (nickel), Edit. 68R
Bronze, Edit. 43L
Plastics, Adv. 81
Steel, Adv. 21, 85

Mechanisms:

Braking, Edit. 32, 33R, 37L
Driving, Edit. 42L
Hydraulic, Edit. 23, 24, 25, 26, 27
Reciprocating, Edit. 32L

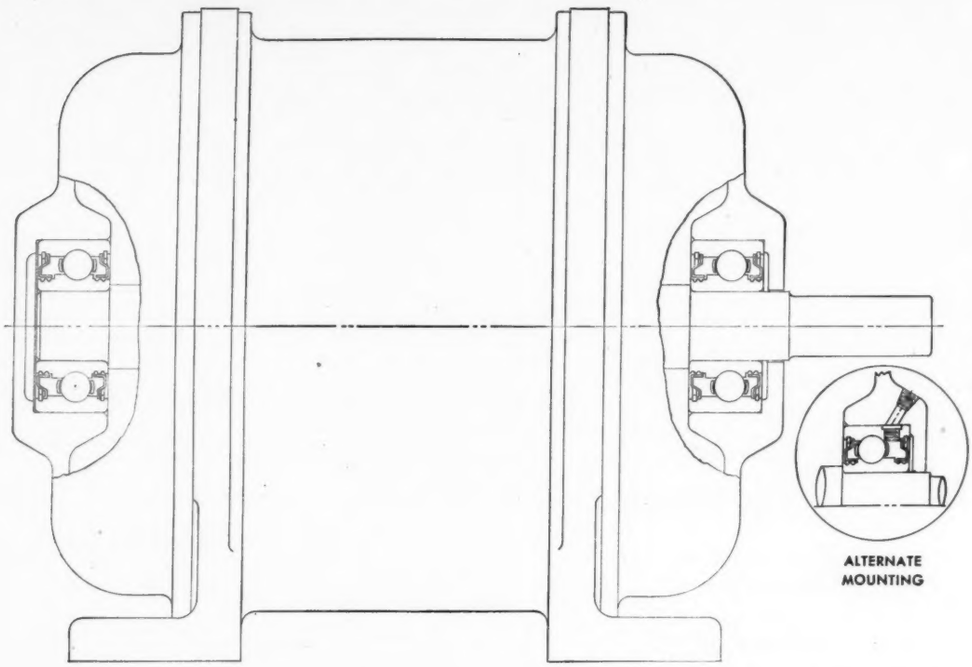
Organization and Equipment:

Engineering department, Adv. 62L, 65, 69, 70L

Parts:

Bearings, Edit. 37R, 62R, 66R, 68R, 72R; Adv. 6, 8, 9, 49, 53, 56L
Belts, Edit. 41R; Adv. 13
Cast parts, Adv. 19, 21, 85
Clutches, Edit. 28, 31; Adv. 70L
Controls (electrical), Edit. 24R, 26, 27, 30L, 31, 33, 42L, 64R, 66R, 68R, 70R; Adv. 12, 67, 74L, 88
Counters, Edit. 73L; Adv. 71
Couplings, Adv. 76L
Engines, Edit. 70R; Adv. 72L
Fastenings, Adv. 17, 61, 80L, 83
Filters, Adv. 63
Gears, Edit. 78; Adv. 60L, 78L
Hydraulic equipment, Edit. 23, 24, 25, 26, 27, 28, 62R; Adv. 14, 15, 66L
Joints, Adv. 68R
Lubrication and lubricating equipment, Edit. 36R, 66R; Adv. 73R, 78L, 82
Motors, Edit. 25L, 27, 31, 32, 33, 41R, 42L, 58R; Adv. 2, 22, 55, 87
Oil seals and packings, Edit. 30R, 34, 35, 36, 37, 38; Adv. 4, 18
Plastic moldings, Adv. 81
Pulleys, Edit. 72R
Pumps, Edit. 25L, 26L, 27, 28, 60R, 74R; Adv. 57, 72L, 76L, 80L, 81L
Speed reducers, Adv. 58L, 60L, 64L, 77R, 83R
Springs, Edit. 24R; Adv. 68R, 74L
Valves, Edit. 24R, 26L, 56R
Variable speed transmission, Edit. 62R, 73R Adv. 2, 3, 79R
Welded parts and equipment, Adv. 10, 86

MODERNIZE THE BEARINGS IN



THE IMPROVED

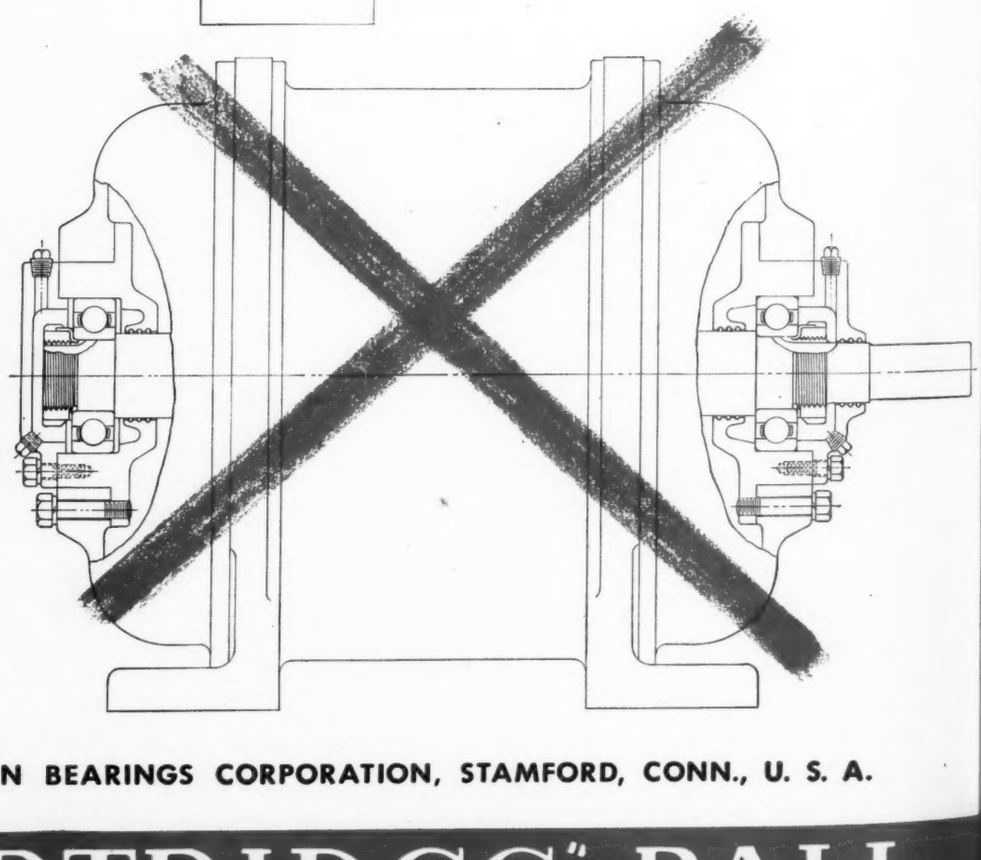
A Part Section of an Improved Motor Mounting with Ultra-Modern "CARTRIDGE" BALL BEARINGS.

THE PRESENT

A Part Section of a Typical Present-Day Motor with Unshielded Ball Bearings in the Conventional Cartridge Type Mounting.

•

See opposite page for machining operations and parts eliminated from this motor.



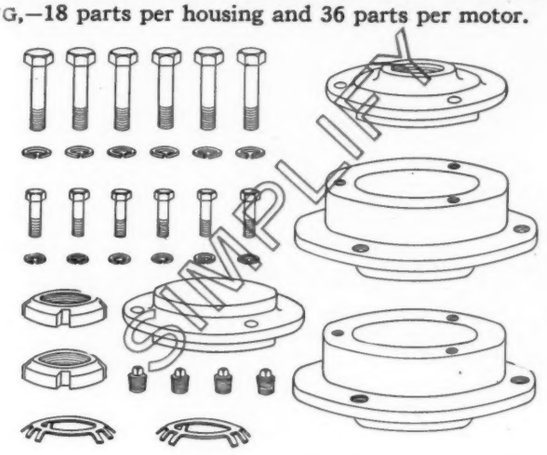
NORMA-HOFFMANN BEARINGS CORPORATION, STAMFORD, CONN., U. S. A.

USE "CARTRIDGE" BALL

YOUR MOTORS!

36 (OR MORE) PARTS ELIMINATED

Below are shown the extra parts required in the conventional cartridge type mounting. THESE ARE ALL ELIMINATED BY USING THE "CARTRIDGE" BALL BEARING,—18 parts per housing and 36 parts per motor.



30 (OR MORE) MACHINING OPERATIONS SAVED

Mounting the "CARTRIDGE" BALL BEARING in the motor housing requires only (1) Boring motor end housing for bearing, (2) Facing housing bore for bearing abutment—4 machining operations per motor.

The conventional cartridge mounting employing the unshielded ball bearing requires 30 additional machining operations per motor.

MACHINING OPERATIONS ELIMINATED

1. Drilling Motor Housing for cap screws.
2. Machining Outer Diameter of Cartridge.
3. Facing Cartridge Flange.
4. Boring Cartridge for Bearing.
5. Facing Cartridge for Cover Plate.
6. Facing Cartridge Bore for Bearing Abutment.
7. Boring Cartridge for Shaft Clearance.
8. Drilling and Tapping Cartridge for Cap Screws.
9. Machining Flange of Cover Plate.
10. Facing Cover Plate.
11. Boring Cover Plate for Shaft Clearance.
12. Drilling Cap Screw Holes.
13. Drilling and Tapping for Grease Fittings and Drain Plugs.
14. Threading Shaft for Lock Nut.
15. Cutting Keyway on Shaft for Lock Washer.

Developed expressly to improve electric motor design and performance, the "ultra-modern" "CARTRIDGE" BALL BEARING offers the following advantages:

SIMPLIFIED DESIGN: As indicated above, eliminates 36 or more parts,—each an inventory burden and potential trouble-maker. Shortens overall length of mounting and reduces overhang of shaft.

ECONOMICAL MOUNTING: Cuts out the many costly machining operations enumerated above. Assures better bearing alignment because of fewer possible variables.

EASIER AND FASTER ASSEMBLY AND DISASSEMBLY: The "CARTRIDGE" BALL BEARING is handled as an integrally sealed, single unit unencumbered by numerous complementary parts.

DIRT HAZARD ELIMINATED: Tightly-fitted seals prevent ingress of foreign matter during assembly, in service and when removing armature. The "CARTRIDGE" BALL BEARING comes pre-packed with clean, "stability-tested," uncontaminated grease.

SLIPPAGE, PEENING AND COCKING PREVENTED due to wider race contact area on shaft and in housing. No locking means required and elimination of threading permits use of stronger shafts.

LONGER LIFE AND LOWER MAINTENANCE, resulting from large, lasting grease supply kept in close proximity to rotating surfaces by highly efficient, wearless metal seals. No "dead" grease space and no leakage irrespective of position of motor.

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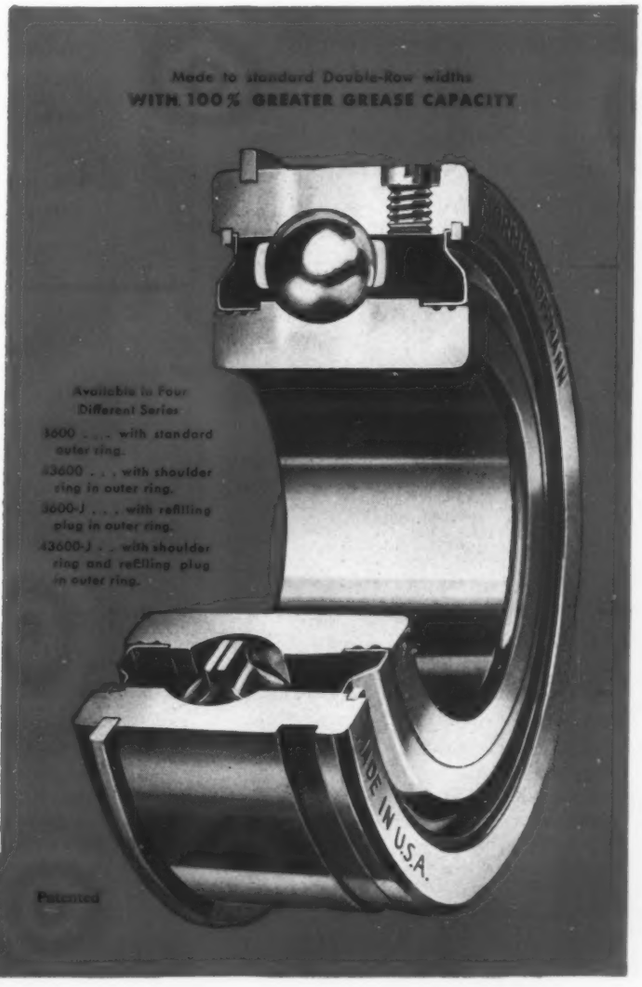
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BEARINGS

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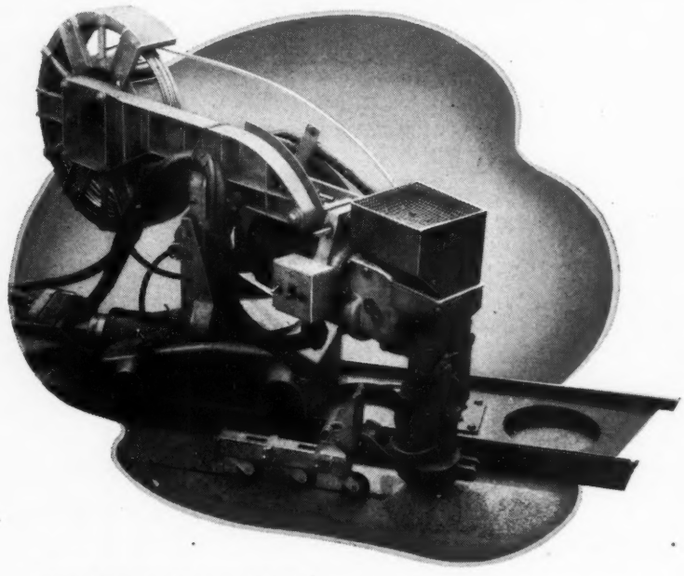
There are many Linde products and processes to speed up production, improve results, and lower costs. Yet even more important, is Linde's accurate knowledge of how best to adapt them to industry's actual needs.

If you are not certain that your operations are realizing full benefit of Linde service, we suggest you talk it over with a Linde man. Any representative can tell you how the Linde organization is geared to bring into your plant the engineering co-operation that means control of costs and efficient application of Linde products. The Linde Air Products Company, Unit of Union Carbide and Carbon Corporation, Offices in principal cities.



UNIONMELT WELDING is a revolutionary electric process that is fully automatic. With it, high-quality welds can be made in one pass at amazing speeds. It is being used successfully in many different industries to make better products in less time and at lower cost. The illustration shows a Unionmelt welding head speeding the fabrication of a barge. Linde research developed this process—and Linde engineers can help you use it.

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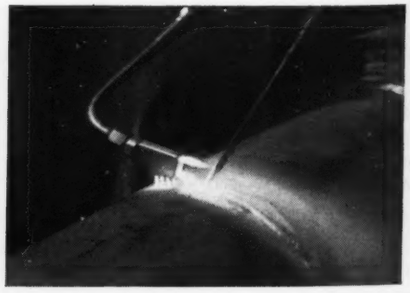

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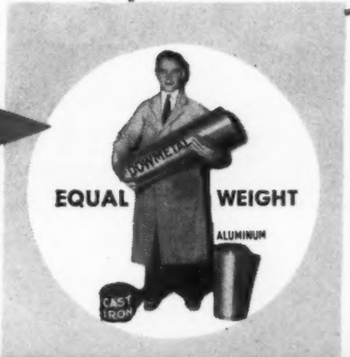
LIGHTEST OF ALL STRUCTURAL METALS

Lifts Products Above Competition



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For Lower Upkeep of Drives and Machinery

DEMAND Super-Flex DAYTON COG-BELTS WITH DAYTEX CORD

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OUTSTANDING IN BASIC DESIGN, Super-Flex Dayton V-Belts are built to bend with patented cog construction. They work on short centers—save space—assure longer life and lower upkeep. Call your local Dayton distributor or write for Catalogs and data.

THE DAYTON RUBBER MFG. CO.
DAYTON, OHIO

FIELD EXPERIENCE CONFIRMS THESE LABORATORY TESTS WHICH PROVE THE OUTSTANDING SUPERIORITY OF DAYTEX CORD

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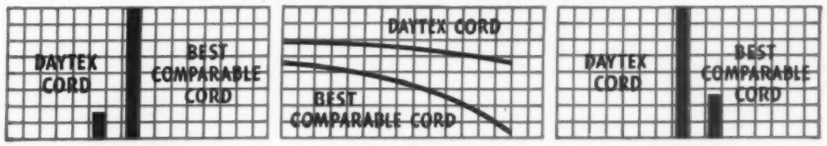
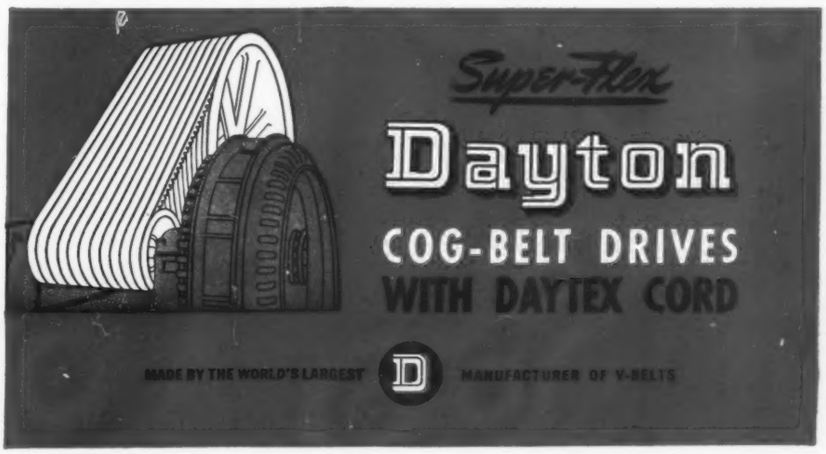


LESS STRETCH *Stretch test-cords.*

STRONGER *Tensile test-cords.*

LONGER LIFE *Belt flexing test.*



AT LAST . . HYDRAUL

PROBLEMS CAN BE SOLVED IN H

IT WAS FOR THIS PURPOS

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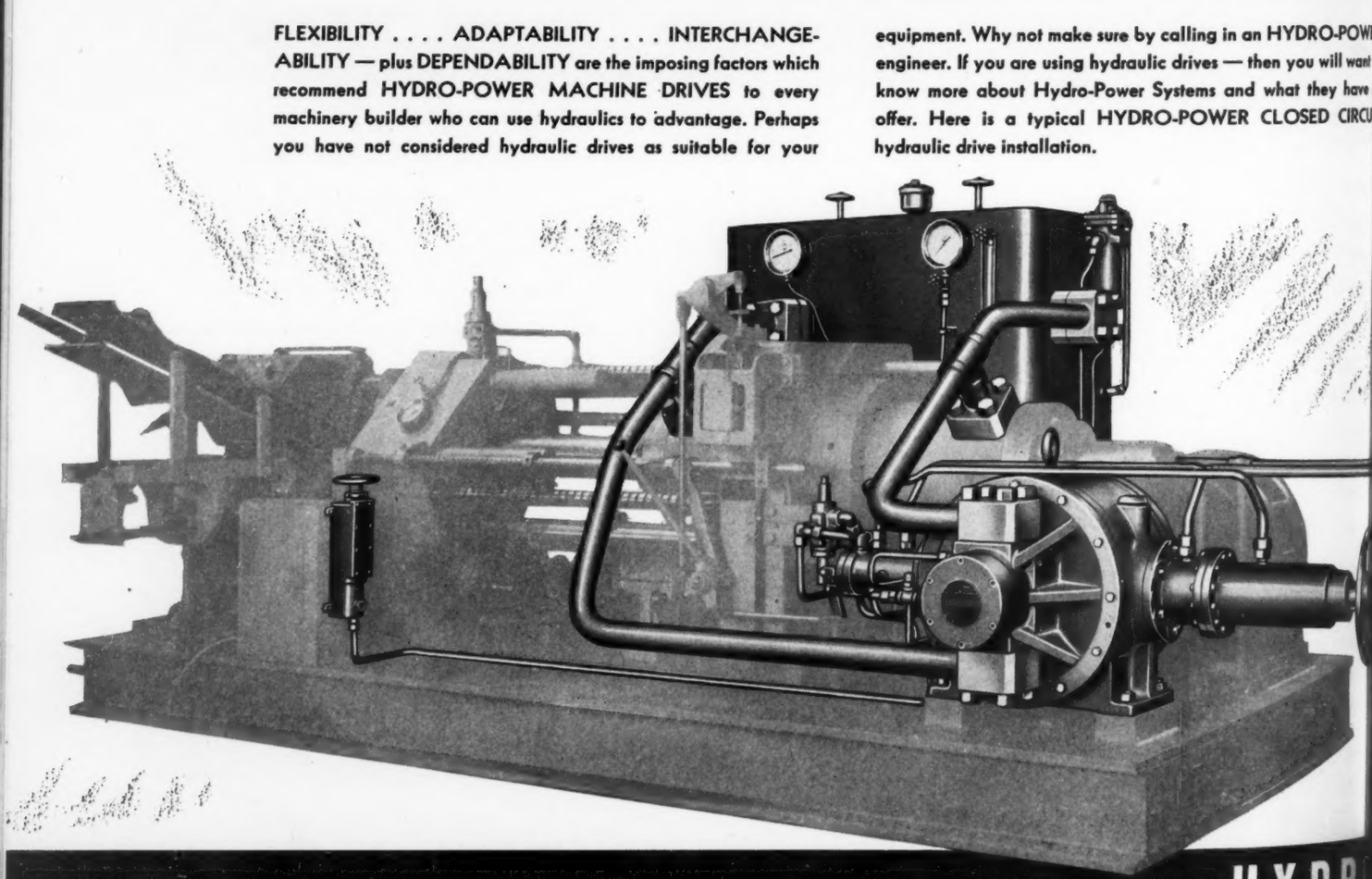
FLEXIBILITY . . . . ADAPTABILITY . . . . INTERCHANGE-ABILITY — plus DEPENDABILITY are the imposing factors which recommend HYDRO-POWER MACHINE DRIVES to every machinery builder who can use hydraulics to advantage. Perhaps you have not considered hydraulic drives as suitable for your equipment. Why not make sure by calling in an HYDRO-POWE engineer. If you are using hydraulic drives — then you will want know more about Hydro-Power Systems and what they have offer. Here is a typical HYDRO-POWER CLOSED CIRCU hydraulic drive installation.



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★ The HYDRO-POWER CLOSED CIRCUIT HYDRAULIC SYSTEM OF OPERATION — so popular with H-P-M Fastraverse Presses — is now available to machinery builders interested in hydraulic machine drives to assure top performance — dependable operation — maximum dependability.

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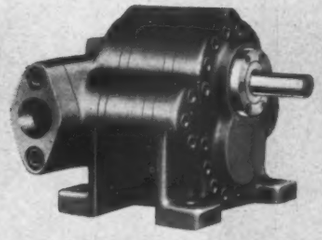
MODELS 4R and 6R RADIAL PUMPS
for generating high pressure, hydraulic power for press and machine operation, strike a new note in radial pump efficiency. In addition to the radial pump characteristics including variable and reversible delivery, it introduces a new mechanical relationship between the pump pintle and rotor that eliminates the shortcomings of conventional design.



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reflect the ultimate in engineering design and efficiency to meet the many diversified operating services they are called upon to perform. To meet these requirements they have been developed in two series — medium pressure and high pressure.

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consist of radial pump, gear pump and electric motor drive compactly mounted on a reservoir containing the oil used as pressure fluid — or directly to the machine it serves.

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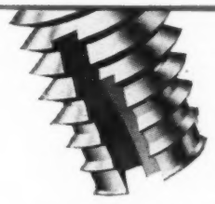

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FOR ALL PLASTICS

A specially designed screw with double thread-cutting slot that drives easily and cuts cleanly in even the toughest of plastic materials!

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also available with PHILLIPS Recessed Heads

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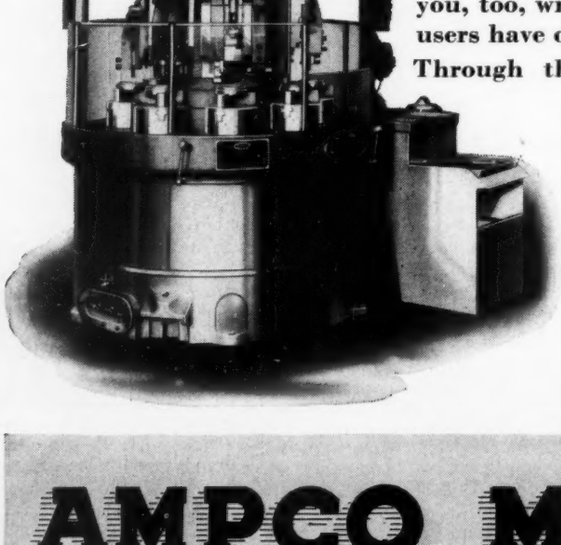
Lock Washers . . . Locking and Plain Terminals . . . Spring Washers . . . Special Stampings

BULLARD USES AMPCO . . . For Many Vital Parts On Their Famous MULT-AU-MATICS



Industry the world over knows The Bullard Company—machine tool builders for more than a half century—and their famous Bullard Mult-Au-Matics.

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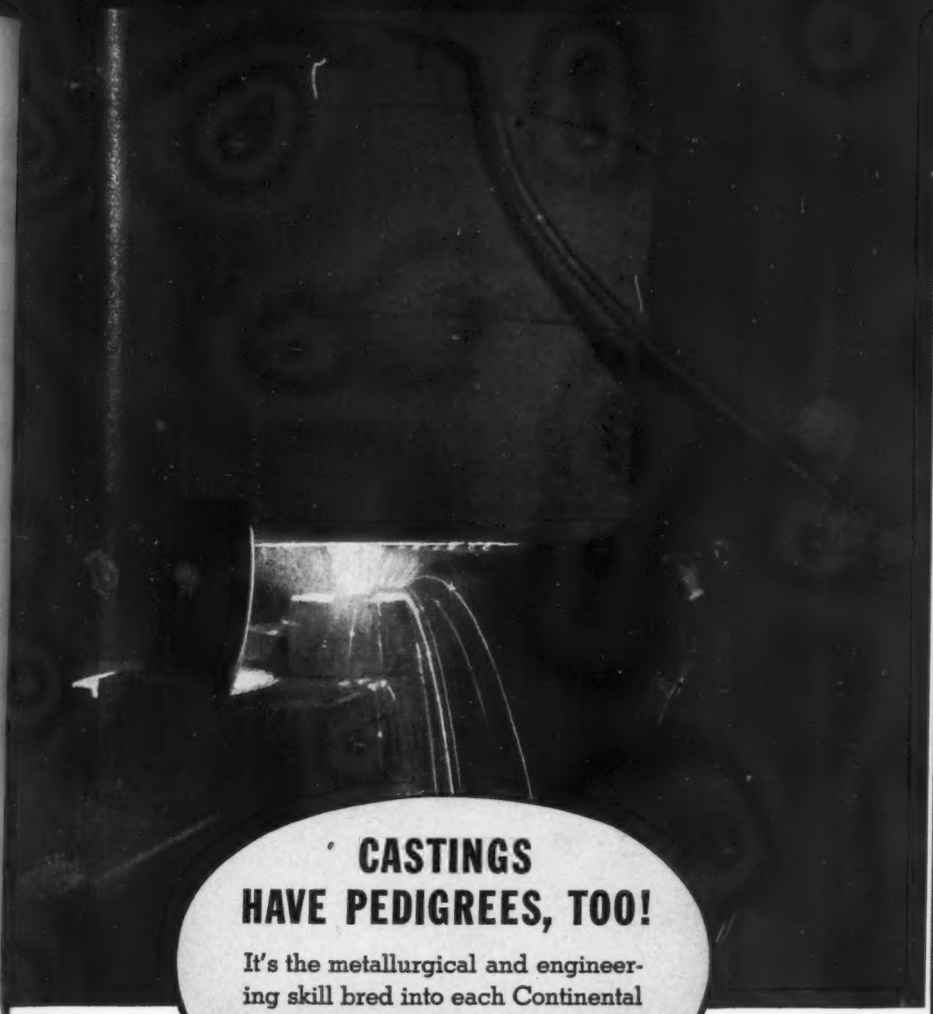

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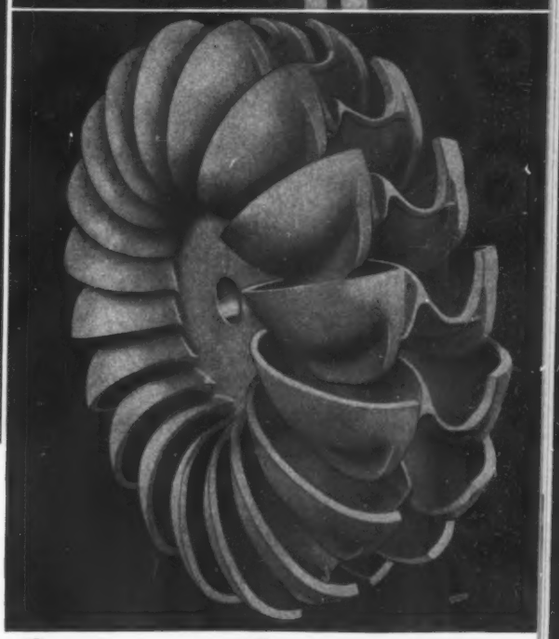

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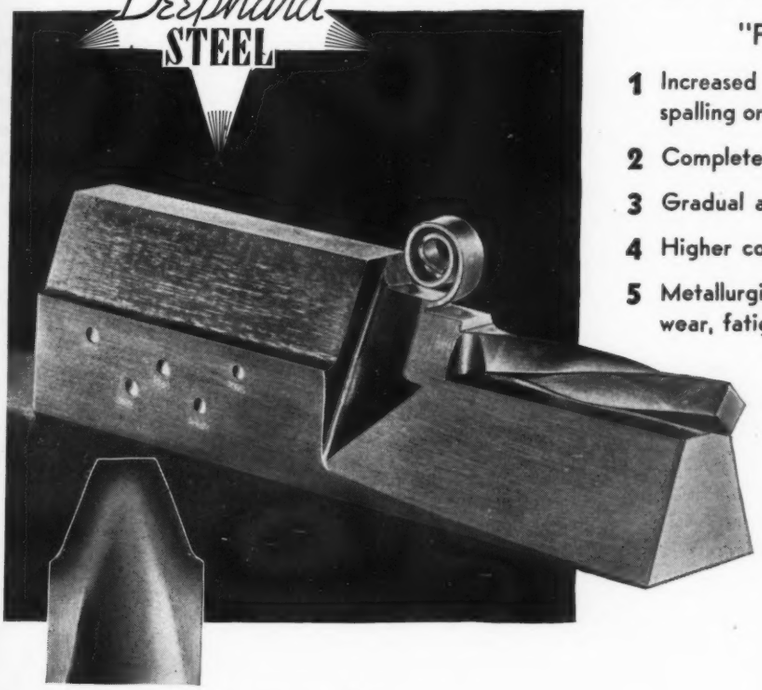

S. A. E. X1020 RACK TOOTH

Face	9"
Width	2"
Thickness	2¾"
Depth of Wearing Surface	.250"
Surface Hardness	66 Rockwell "C" 712 Brinell
Core Hardness	18 Rockwell "C" 202 Brinell

The exposed, twisted and curled core sections are evidence of extreme ductility and strength. The end view of this tooth shows the gradual and even diffusion of the wearing surface with the core. TWO of the important "FIVE-POINTS" of superiority.

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"FIVE-POINT" REASONS WHY:

1. Increased hardness in wearing surface without fear of spalling or flaking.
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Rolls	Wrist Pins
Shafts	Armature Shafts
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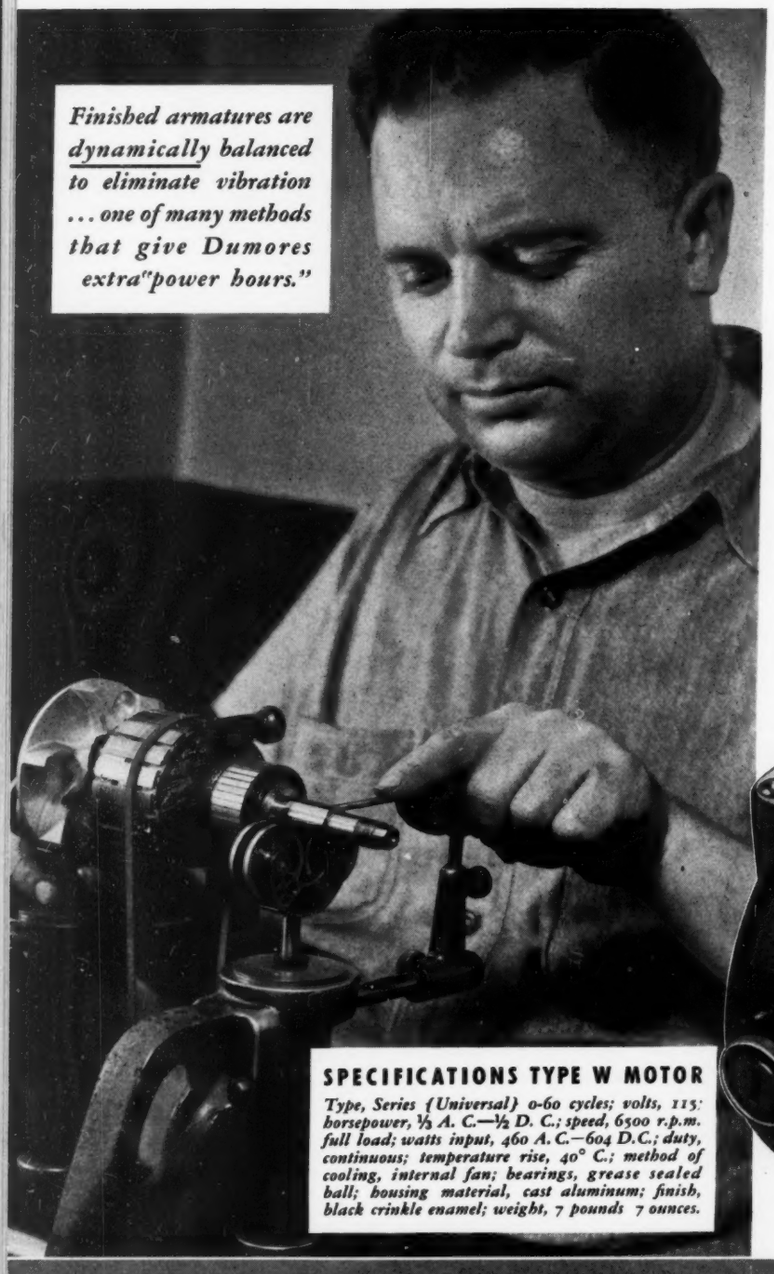
THERE ARE 5 quarts IN A DUMORE GALLON



Finished armatures are dynamically balanced to eliminate vibration ... one of many methods that give Dumores extra "power hours."

SPECIFICATIONS TYPE W MOTOR

Type, Series {Universal} 0-60 cycles; volts, 115; horsepower, 1/3 A. C.—1/2 D. C.; speed, 6500 r.p.m. full load; watts input, 460 A. C.—604 D.C.; duty, continuous; temperature rise, 40° C.; method of cooling, internal fan; bearings, grease sealed ball; housing material, cast aluminum; finish, black crinkle enamel; weight, 7 pounds 7 ounces.

Long after many a motor runs out of "gas" and gives up the ghost, a Dumore will keep right on going . . . fresh as a sprinter getting his second wind. Dumore's reputation for delivering extra "power hours" is the reward of employing sound, accurate manufacturing methods — tried and proved by 25 years of relentless research and exhaustive field tests.

Religiously employed by skilled workmen long experienced in the Dumore plant, these methods include: (1) Dynamic balancing of armatures to eliminate vibration (2) Swaging of commutator leads for 100% electrical contact by special Dumore process (3) Grinding of commutators concentric with bearings for longer brush life (4) Expanding of armature windings, then double sealing, to prevent centrifugal "breathing" (5) Inspection of motors 5 times in manufacture and running in to seat brushes properly.

Add to the life of your product with any one of Dumore's AC—DC motors . . . 1/500 to 2/3 h. p. . . . 0 to 60 cycles. Dumore engineers will gladly help you in adapting the correct unit for your particular needs. Dumore's tailor-made motor parts are available for special adaptations. Write for facts and engineering service application blank.

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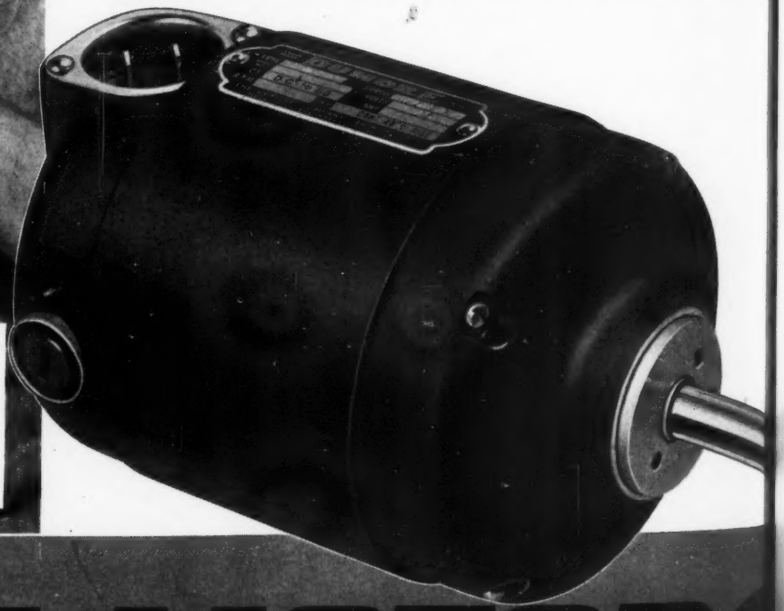


DUMORE MOTORS

FOR *Extra* POWER HOUR

Hydraulics Cannot Be Denied!

Part II

By Hans Ernst
and
Albert H. Dall

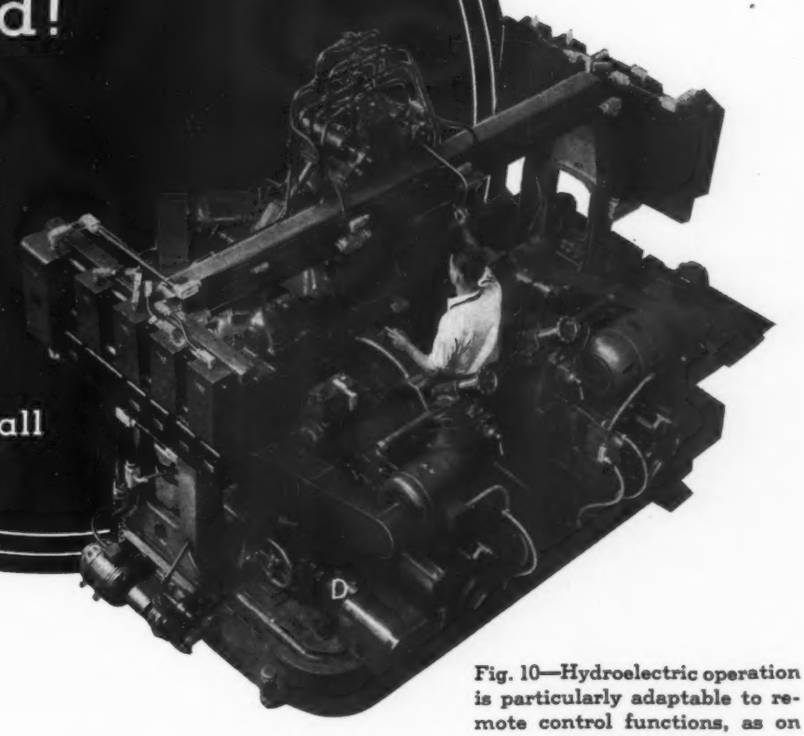


Fig. 10—Hydroelectric operation is particularly adaptable to remote control functions, as on this unit grinder

IN PART I of this series of articles, representative machines and circuits were shown to prove that in modern engineering practice, hydraulics can neither be denied nor ignored. The examples cited were those of milling machines in which the path and rate of movement of a work piece with respect to a cutter or cutters were controlled. It was shown that hydraulic controls were admirably suited to these functions, even to the extent of actuating sensitive mechanisms responsive to movements of less than one thousandth of an inch. For this type of control a special resistance pilot valve has been employed, the electrical analogy of which is the modern micro-relay that actuates a secondary switch through the medium of a solenoid.

While the use of electrically energized primary mechanism is no longer necessary from the standpoint of sensitivity, a combination of electrics and hydraulics is sometimes justifiable from the standpoint of economy or simplicity. In such cases a useful device is the electrosolenoid-operated hydraulic valve—a product now marketed by several manufacturers. These solenoids can be operated either by a pushbutton or limit switch.

The hydroelectric type of hydraulic control has been found to be particularly adaptable to machines where a multiplicity of remote control functions is

necessary, such as indicated on the unit center type grinding machine shown in *Fig.* 10.

In this machine four distinct grinding operations are performed simultaneously by four independently driven grinding wheels. *Fig.* 11 shows an automobile rear axle in position, exemplifying the type of work done on this machine. At the left end the back face of the differential bevel gear is ground by a wheel set at approximately 45 degrees, while another wheel grinds the bearing diameter adjacent to the bevel gear. Simultaneously two wheels working from opposite sides grind the taper and straight portion shown at the right end of the axle shaft. *Fig.* 12 shows a sketch of these wheels and their relation with the work piece.

The automatic cycle of operations on this machine is as follows:

(a) Work is brought into position by fingers attached to a hydraulically actuated slide (See *Fig.* 11)
(b) Centers and driver are moved by hydraulic means to engage the work piece
(c) Centers are clamped hydraulically
(d) Work begins to rotate and the wheels feed rapidly to grinding position
(e) Work is ground to the finished size
(f) Wheels drop away to their original positions
(g) Work stops rotating
(h) Centers unclamp and retract
(i) Work is unloaded, hydraulically, and the cycle stops.

This cycle is repeated by throwing starting lever.

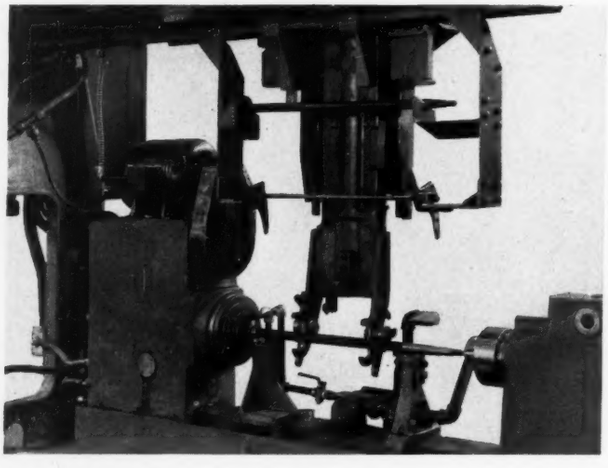


Fig. 11—Above—Four independently driven grinding wheels on the machine in Fig. 10 perform work simultaneously on this automobile rear axle. Fig. 12—Below—Sketch of the wheels in Figs. 10 and 11 and their relation with the work piece. Cycle of operations is automatic

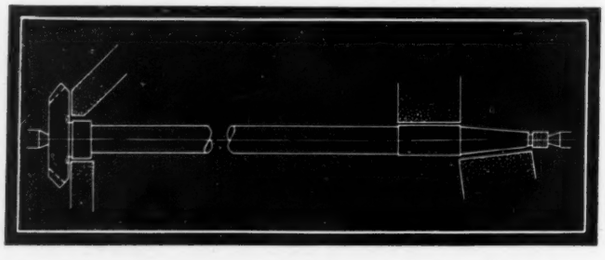


Fig. 13 is the schematic hydraulic diagram showing the operation of valves and pistons. The solenoids are shown on each end of the valves, but for the sake of simplicity all of the other electrical controls are eliminated from the diagram. Operation of the starting lever actuates the valve *A* which in turn causes the loading cylinder to act. Limit switches on the loader cause the center actuating valve *B* to act when the loader has completed its function.

Limit switches on these centers cause the clamp valve at *C* to act and at the same time cause the feed motors (shown at *D, Fig.* 10) to begin rotation of the feed cams which bring the grinding wheels to the piece. Limit switches on these cams stop the feed motors through relays and initiate a reversal of the sequential operations, beginning at (f) in the schedule of the cycle.

Jog Mechanism Is Hydroelectric

A novel feature of the wheelhead circuits is the hydroelectric jog mechanism for inching the wheels toward the work. This mechanism permits the operator from his position shown in *Fig.* 10 to move any one of the wheelheads toward the work in small increments (approximately .0001-inch). Reversing valve *F* in *Fig.* 13 is solenoid-operated through a pushbutton. When the pushbutton is depressed the solenoid on valve *F* causes the valve to move to its extreme left position. The piston is then forced to its left end position which operates the ratchet and feeds the head forward through gears and the feed screw. When the pushbutton is released the solenoid is de-energized and the spring returns the valve to its right-hand position which again returns the piston to its original position. It will be noted that the forward pressure for this inching operation is taken from the high pressure line when the loader is in the unloading position. The check valve at *G* brings about this condition since no oil can return through line *H*. Movement, therefore, can take place only when oil is entering the check valve at *G*. In like manner the diamond truing attachment can only be operated when the wheels are not in the grinding position.

As shown in *Fig.* 10, the controls for the many functions, including the size adjustment described above, are manipulated by means of a set of pushbuttons at the eye level. The infrequent operation of truing the wheels, however, is controlled on each individual head by means of the valve *L* (Fig. 13).

The grinding wheel traverse slide on large roll grinders is required to move with extreme smoothness and at the same time have a maximum feed rate one hundred times the minimum feed rate. *Fig.* 14 is an example of the traveling wheelhead type of roll grinder. The roll is held in journal rests which are mounted on a bed. This type of design is necessary because of the enormous weight of the

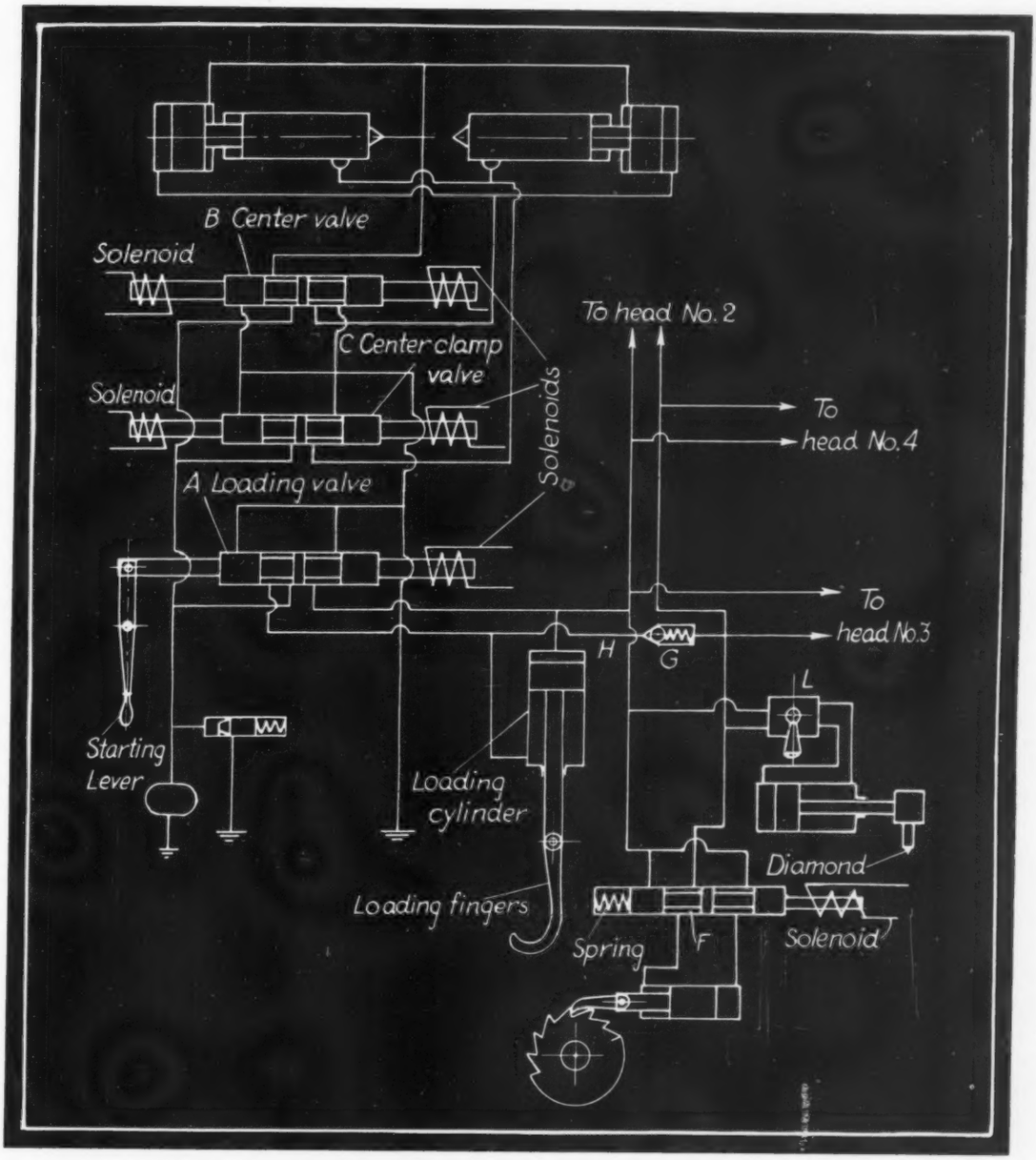


Fig. 13—Schematic hydraulic diagram showing operation of valves and pistons on grinder, solenoids being shown but not other electric controls. Many remote control functions are involved

rolls which in some cases are 12 feet in length and 5 feet in diameter.

The table traverse for this machine is hydromechanical in that a rotary hydraulic motor is used in conjunction with reduction gears to rack and pinion. Torque of the motor is a function of the pressure and since the pressure is determined by a relatively constant resistance to motion the torque output of the motor is almost constant regardless of speed of rotation. Variations in feed rate are accomplished by changing the delivery of the variable delivery pump. Rapid traverse of the table is obtained by manipulation of lever *B, Fig.* 15, which controls

Fig. 14—Table traverse for large roll grinder is hydromechanical, a rotary hydraulic motor being used with reduction gears to rack and pinion

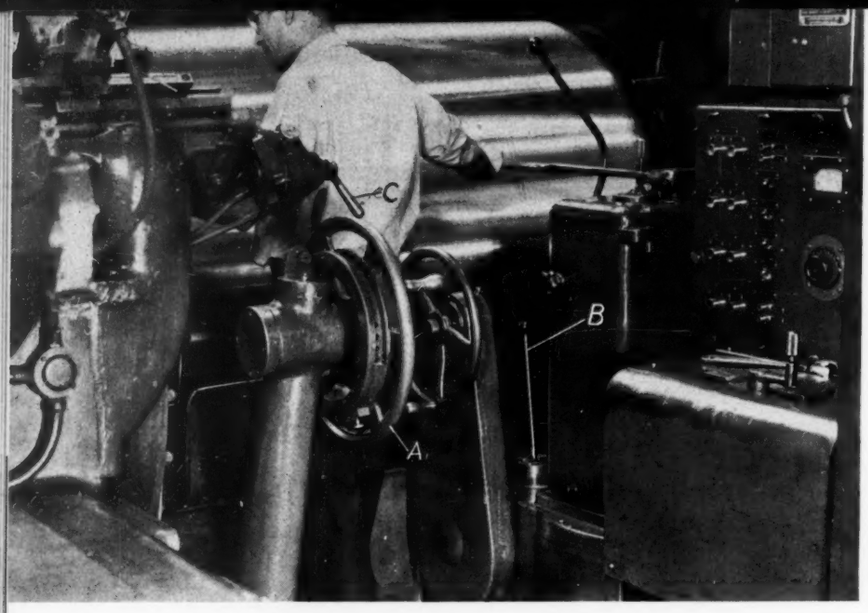
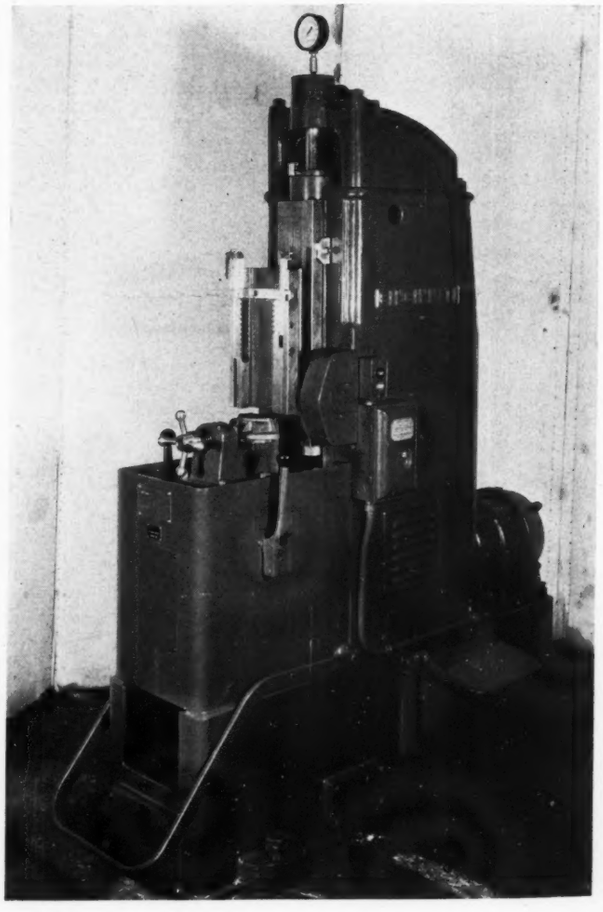


Fig. 15—Left—From his position, operator obtains rapid "in" and "out" motions of the wheel slide, regulates sizing by a handwheel, operates wheel-truing device

Fig. 16—Below—Small vertical broach for crankshaft bearing caps, cycle being controlled and part clamped hydraulically by lever at operator's right hand



the rapid traverse valve. The delivery of a large constant displacement pump is added to the feed pump delivery for rapid traverse.

Fig. 15 shows the operator riding the carriage, literally surrounded by mechanical, hydraulic, and electrical controls. From his position, rapid "in" and "out" motions of the wheel slide are readily obtained by means of an hydraulic cylinder operating a slide. Small increments of motion are afforded for sizing when the handwheel at *A, Fig.* 15, is operated. In addition to these functions the diamond truing device is operated hydraulically by means of lever *C.*

The hydraulic unit including pumps and piping is shown at *A, Fig.* 14, with only the tank-filling pipe showing.

It was said in Part I that at the recent Leipsig Fair 100 per cent of the broaching machines shown there were hydraulically actuated. It is therefore fitting to discuss broaching in any article on hydraulics because of its universal acceptance as the propelling means for broach carriers. Widespread use of hydraulics for broaching is easily explained. The motion is purely translatory; rates are rapid; forces are high; and motion must be smooth. These requirements are fully met by hydraulic applications.

Fig. 16 shows a small vertical broach for crankshaft bearing caps. Hourly output is in excess of 300 pieces, while the accuracy and finish is comparable to that of grinding. Broach tools finish the crankshaft cap lock surfaces on the down-stroke and the fixture is reloaded on the up-stroke. The cycle is controlled and the part is clamped—all hydraulically—by means of the lever at the operator's right hand.

One of the problems faced by the designer of broaching machines is that of dulled tools and means for apprising the operator of the imminence of this hazard. As broach tools become dull, it is only natural that the pressure required to remove the metal will increase. A novel method of short-circuiting the pump and stopping the machine is used in this instance. A latch type valve is employed instead of the usual emergency relief valve. This valve performs the analogous function of an overload relay in an electrical circuit. In *Fig.* 17, when the pressure *P* times area *a* exceeds the spring pressure *S,* the latch lifts and the oil from the pump is short-circuited to the tank through port *A.* The valve is relatched manually but obviously will not stay in the closed position until the cause of the excessive pressure has been eliminated.

Another method of obtaining this result is by the use of the electrical pressure switch. These switches can be made to open a relay when the pressure

reaches a predetermined value, thus stopping the pump driving motors. However, the delay caused by inertia effects in the pump and motor as well as in the broach ram may cause irreparable damage to the broach. The latch type relief valve gives an immediate result with only the inertia of the slide having a detrimental effect.

An unusual application of the broaching operation is shown in *Fig.* 18. This gigantic machine consists of two vertical columns on which flat broaches are mounted. Between these columns automobile cylinder blocks are moved vertically by means of a sunken hydraulic cylinder. The operation performed is that of broaching both ends of the cylinder block simultaneously in the remarkable time of less than one minute per piece. In actual operation the blocks are loaded at floor level, broached, and unloaded at an upper floor level.

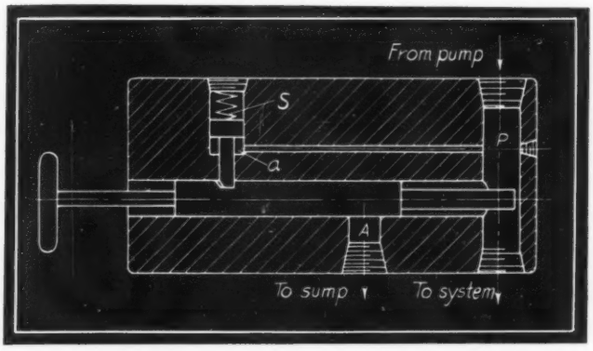


Fig. 17—Above—Method of short-circuiting pump and stopping machine when broaching tools become dull. A latch type valve is used

Interconnected hydraulic tanks are located in each column below the two electric motor-driven pumping units. The work is loaded and unloaded by electrical means. Chip disposal is accomplished by means of the two vacuum units shown on each column. As the chips fall from the broaches they are sucked through the pipes to the hoppers which are cleaned at convenient intervals while the machine is in operation.

Pushbutton controls for the various hydraulic and electrical functions are shown. A small lever at *A* can be used to stop or reverse the ram at any time during the cycle. At *B* is shown a solenoid-operated hook which comes into action if the power fails and is so placed as to prevent the ram from slowly settling after the cylinder block has been unclamped at the top of the stroke. Other electrical features are incorporated in this machine, both for protection of the operator and expensive tools.

In closing let us repeat that the designer cannot now deny hydraulics nor ignore its many advantages. This article cites merely a few of the many hydraulic machine tool applications which are in use today. Both the fully hydraulic and the hydroelectric type of system have their place in modern design.

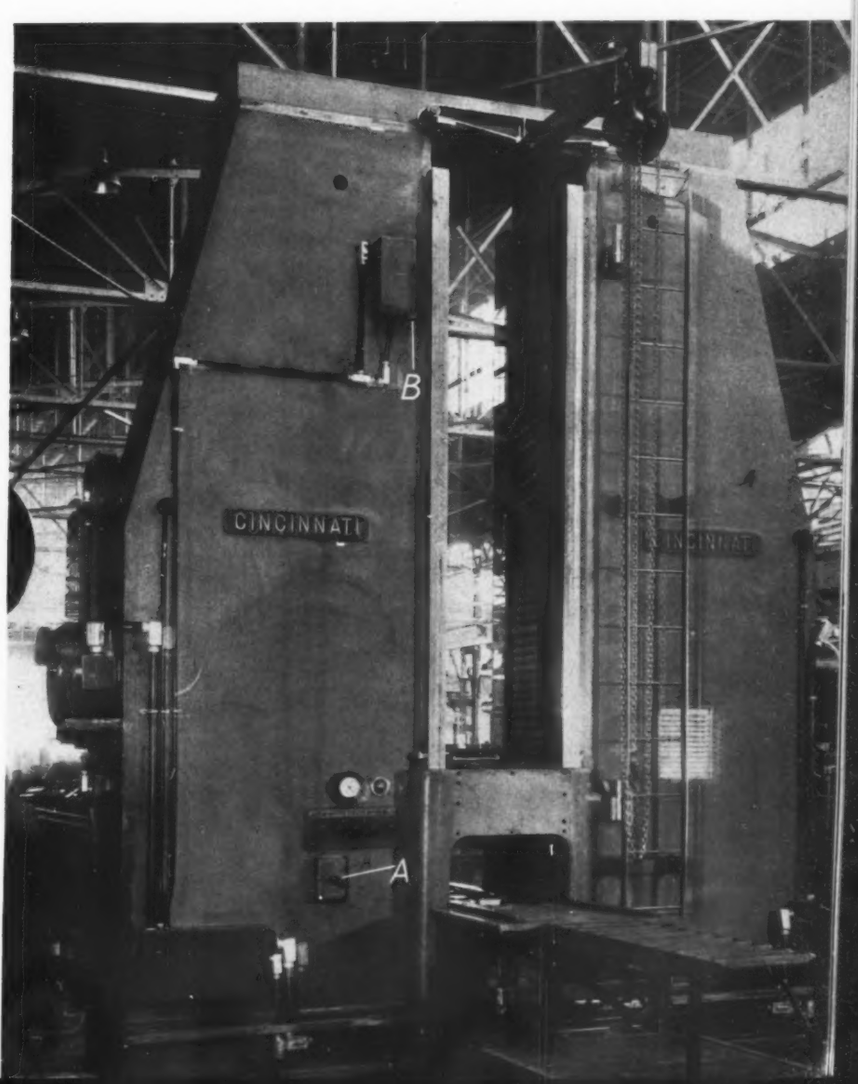


Fig. 18—Right—Gigantic machine for broaching automobile cylinder blocks which are moved between two vertical columns by means of a sunken hydraulic cylinder

Scanning the Field FOR IDEAS

Hydraulics Provides Gear Changes

HYDRAULIC power for automatically changing machine speeds has been applied to a new device for quickly selecting any available speed. In a unit developed by the Gisholt Machine Co. the operator has a choice of three methods of control—direct, preset or high-low speed changes. With these changes, effected by turning a dial or pressing a lever, machine production may be kept at its maximum and in addition no time is lost for gear changes.

Proper setting of the dials shown in *Fig.* 1 precludes the necessity of calculations. When set for the best cutting speed for the tool and material, the required speed is obtained automatically by turning the handwheel dial to the diameter of the work. The preset method allows selection of the next desired speed in advance of the actual change. By merely pressing a trip the change is then made. The high-low method may be used in conjunction with either of the two aforementioned procedures. It provides a quick change to either speed by pressing or lifting a trip.

Oil pressure is supplied from a pump as illustrated in the diagram, *Fig.* 2. Values in the selector control the position of the three hydraulic pistons shown.

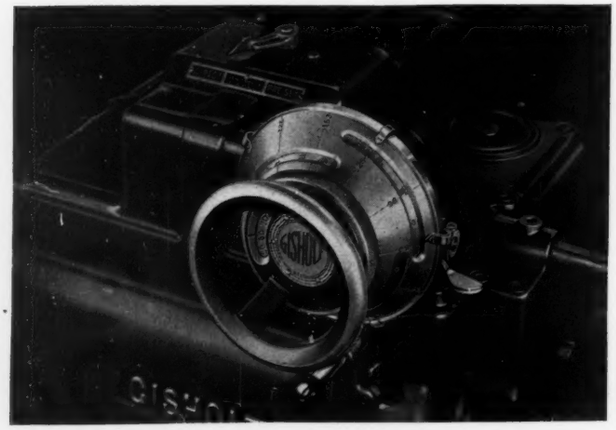


Fig. 1—Twelve speeds in geometric progression are selected by turning handwheel. Dials act as slide rule precluding necessity of calculations

One shifts the high-low clutch, the second carries a yoke which shifts the triple gear and the third shifts the double gear. Twelve speed changes, arranged in geometric progression, are thus provided by the gear train. Two double multiple-disk clutches

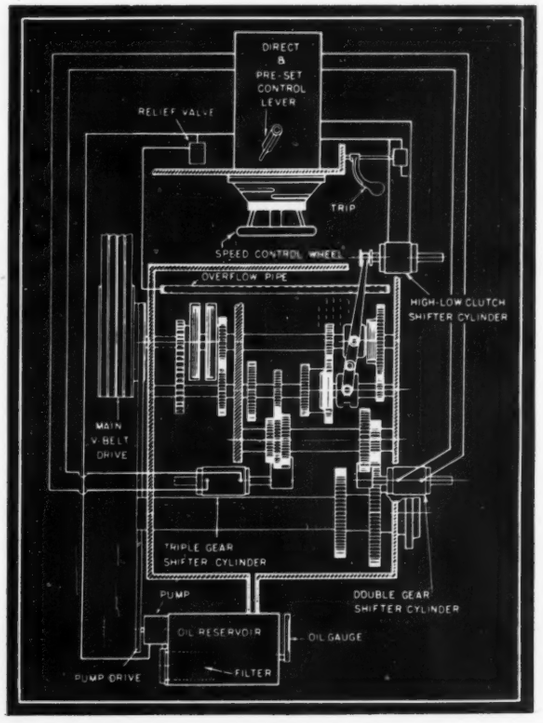


Fig. 2—Diagram illustrates arrangement of hydraulic control for speed changing. Position of each piston is determined by the setting of the handwheel

provide quick speed change between the high and low ranges without shifting gears. They also operate as a part of each gear change.

When the oil supplied by the hydraulic pump is not required for selecting speed changes, it is discharged through a relief valve and cascades over the gears. The oil returns to a reservoir and is filtered before again passing through the pump.

Variable Capacity, Constant Velocity

VARIABLE capacity atomizers for fuel oil burners which operate efficiently over a wide range without danger of carbonizing either the orifice or furnace walls embody important improvements of interest to designers.

Conventional atomizers have limited operating ranges without manual change of orifice, the reason

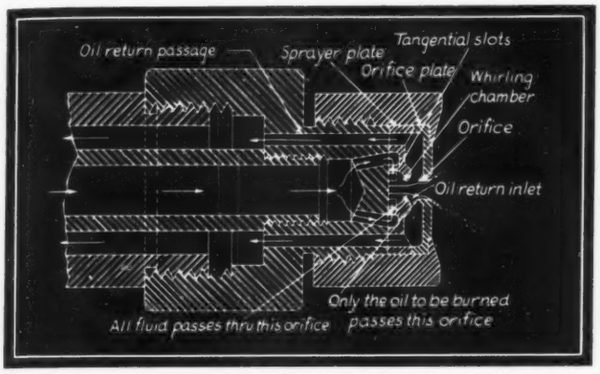


Fig. 3—Uniform velocity and cone angle for atomizer gives better operating characteristics

being that the quantity of liquid passing through the orifice is proportional to the square root of the inlet pressure. Also, any change in the orifice spray might carbonize the furnace walls. Thus a unit with a constant orifice and pressure has been designed by the Todd Combustion Equipment Co. which varies its capacity by a by-pass return at the nozzle. This atomizer, discussed recently in a paper before the Society of Naval Architects, provides a constant angle of spray cone without carbonization over its entire range of operation.

The design, illustrated in *Fig.* 3, consists principally of parts similar to ordinary atomizers with the addition of an oil return passage and separate atomizer orifice plate. This separate plate has the same diameter orifice as the sprayer plate and is in alignment with it. Oil return is provided by an annular space made by the dome-like orifice plate. Return passage is a large tube surrounding the supply tube.

Oil under pressure is delivered through the inner tube, passing into a whirling chamber through a series of slots. These slots are tangent to the chamber side wall and cause the oil to follow a spiral path as it progresses toward the outlet. Pressure parallel to the axis of the sprayer plate is converted into velocity in the same direction because of venturi action of the whirling chamber and its orifice.

At the same time, the whirling oil sets up a centrifugal pressure perpendicular to the axis of the sprayer plate. Oil to be by-passed is forced into the return opening by this force and oil on the inner wall of the vortex moves to the position occupied by the by-passed oil. It thus leaves the orifice with its velocity undiminished for atomization. Quantity of oil returned is a function of the pressure in the return chamber. Increasing the valve opening reduces the pressure and increases the quantity returned.

Atomization is constant quality over the entire range which for one unit is 76 to 1. Regardless of the amount of oil returned, the velocity and cone angle of the oil are constant and proper atomization takes place. The sum of the oil atomized and that returned always equals the maximum capacity of the unit.

Microphone Controls Mill

SOUND has been used to control manually the operation of machines such as grinding mills for many years as an indication of grinding efficiency and fineness of grind. Because the sound levels of each particular system are a function of the load and condition of the material being ground, the Hardinge Company, Inc. has applied a feeding mechanism with a micro-

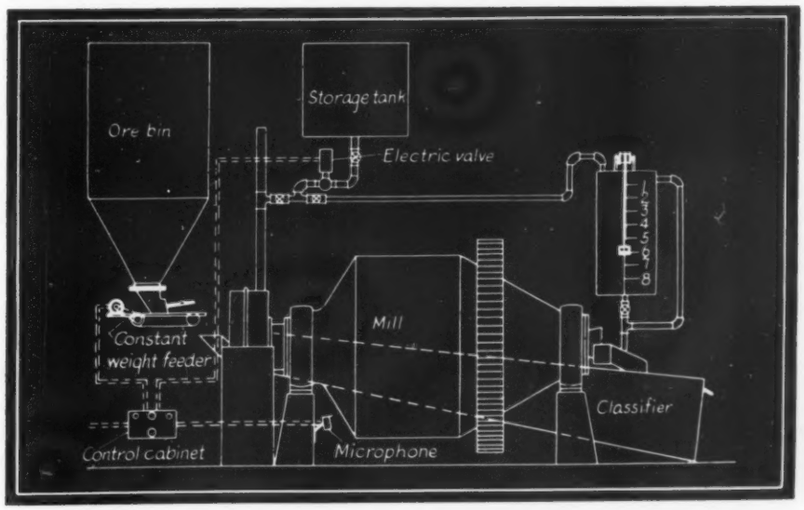


Fig. 4.—Sensitive microphone controls operation of grinding mill feed by sound. Variations in fineness of grind are controlled and overloads prevented by maintaining correct noise level

phone control to various mills of the ball, pebble and rod types.

Equipping the mills with this type of feeding mechanism increases production 10 per cent and produces uniform products as well as extends the life of mill lining and balls. *Fig.* 4 illustrates a diagrammatic arrangement for grinding employing this device, known as an "electric ear." A microphone is placed to receive the maximum sound level from the mill and is insulated from extraneous noises which might affect its sensitivity of control.

A relay is adjusted to operate from any desired sound level as picked up by the microphone. From the energized relay, connection is made to operate the feeder motor or switch. If the feeder is driven from a lineshaft or directly from the mill a solenoid is used to actuate a pawl or clutch to start and stop the feeder.

Motor Uses Compressor Bearings

MANY types of motors have been built into machines resulting in space saving and simplification. An excellent example, permitting the elimination of motor bearings as such, is incorporated in the design of a compressor recently announced by the Sullivan Machinery Co. Illustrated in the cross-sectional drawing in *Fig.* 5, the crankshaft is supported by three main bearings, two on the motor end and one on the other. On its extension is mounted the rotor of the motor, precision fitted. Due to the large diameter of the shaft extension and the double bearings there is no deflection, thus assuring an even magnetic air gap between the rotor and its frame. The motor frame is bolted directly to the compressor, precluding any possible misalignment.

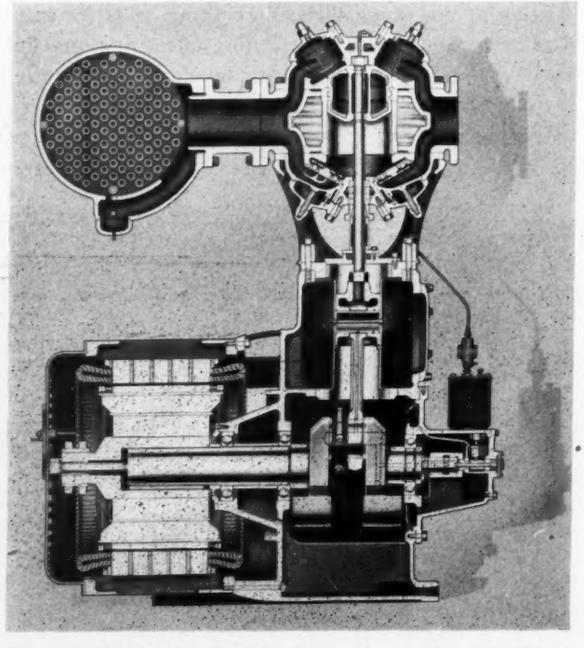


Fig. 5—Compact compressor unit utilizes built-in motor with common bearings for motor and crankshaft

Provisions for oiling are simplified in that all bearings adjoin the crankcase and are lubricated by a spray of oil from the moving parts. Drive parts are readily accessible and easily replaced in case of failure or where a motor of a different rating is required.

Packings Utilize Metal and Rubber

NEW rod packings employing radial displacement of a series of rings to effect sealing are being used on many troublesome applications. A specific design of this new type of packing is shown in *Fig.* 6 which gives long service even for severe jobs involving high pressures and heat.

Two metal rings convex on one face and flat on the other are the sealing mediums on the shaft. For some applications these rings are babbitt metal while for others requiring high temperature operation a special metal is employed. Between these rings are synthetic rubber rings concave on both faces to mate with the convex faces of the metal rings. Beryllium copper springs are embedded in the rubber and seat themselves in recesses provided in the metal rings.

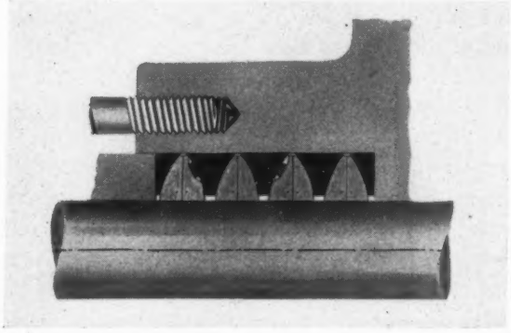


Fig. 6—Reduced friction and longer life are obtained with packing using metal rings

When applied to a centrifugal unit the springs prevent the packing from turning with the rod. On reciprocating rods, they exert an inward and downward pressure to offset any irregularity of the rod. They also compensate for low follower heads and any up-and-down motion or sidesway.

Floating seal under all conditions is provided by this construction. The metal rings seal the rod but do not touch the stuffing box; the rubber rings seal the stuffing box but do not touch the rod. Friction is low because only the metal rings are in contact with the moving rod. Exceptional service in a number of applications has been obtained with this unusual packing, manufactured by Rodpak Manufacturing Co. An example is a compressor handling gas at 170 pounds pressure. The new packings have a greatly extended life as compared with previous devices.

That Question of Cost!

By R. S. Elberty

ELECTRIC drives in machines show many advantages such as flexibility and ease of control. In applications wherein the merits of electric drives are outstanding, cost should be given secondary consideration. However, on many machine tool applications there is little difference between drive alternatives; cost then becomes a determining factor in choosing between them. Experiences of the Landis Tool Co. in comparing costs of electrical, hydraulic, and mechanical drives show that the price structure of electrical equipment might well be revised to enable electrical drives to compete in costs with other drives.

First source of power in a machine tool is the electric motor and to this extent drives all start from an electrical source. On large machines the cost of mechanical or hydraulic linkages between machine members is usually high, and separate machine motions can be equipped with individual electric drives at relatively lower expense. Here again is seen the dominating influence of electric drives.

A commonly used drive is the rotating, reversing type. Simple electrical reversing of an induction motor requires a minimum of electrical equipment, a reversing controller and a limit switch. The mechanical equivalent consists of reverse gears and a clutch, likewise simple and inexpensive mechanisms. Analyzing a three-quarter horsepower application shows little to choose between the initial costs of the two types of drives.

Multispeed rotating drive is also widely used on machine tools. Simple forms of speed change drives might be:

(1) Direct current adjustable speed motor and control as illustrated in *Fig.* 1.
(2) Alternating current four-speed motor and control
(3) Step pulleys and belt shifting means similar to that shown in the illustration, *Fig.* 3
(4) Gear shifting mechanism as in *Fig.* 3.

A cost comparison of these typical drives for three-quarter horsepower constant torque shows that the

INITIAL cost . . . operating cost . . . final cost . . . all with relation to appearance and performance provide subject matter for controversy. Electrical engineer with Landis Tool Co., Mr. Elberty, author of the accompanying article abstracted from a paper presented at the recent forum on machine tool electrification held at the Westinghouse plant in East Pittsburgh, presents an argument for reduction in cost—with consequent increased use—of electrical equipment. Is he right?

electrical speed change drives (1) and (2) cost from 30 to 100 per cent more than the mechanical speed change drives (3) and (4).

Reversing and multispeed drives can be combined with a rack and pinion to form a reciprocating straight line drive. This drive can also be obtained with a hydraulic pump, piston, cylinder, and reverse valve. A comparison of three-quarter horsepower short reciprocating drives shows that electrical drives exceed the mechanical and hydraulic drives by from 40 to 80 per cent in cost.

Wide Speed Range Obtainable

Hydraulic rotating drives have been used to obtain adjustable speeds. Direct current motor drives, either field control or variable voltage control, compare with this type of drive. Where a source of direct current power is available, the direct current adjustable field motor drive is preferable from a cost standpoint. If a motor generator set must be furnished, the variable voltage drive costs but little more and furnishes wider speed control. A comparison of a five horsepower constant torque hydraulic rotating drive with the equivalent variable voltage drive shows that the hydraulic drive costs about 10 per cent more than the electric drive.

Due to possibilities of improved appearance and compact design, shell-type motors are growing in favor for machine tools. The advantages of this type of drive should be carefully weighed against increased cost. A five-horsepower, 1750 revolutions per minute, shell-type motor costs from 100 to 143 per cent the price of a standard motor, and the addition of shaft, frame, brackets, and bearings will increase cost from 15 to 75 per cent more.

Many electrical braking devices have been used to good advantage on machine tools. For automatic cycles one of the forms of electric braking is often desirable, but for the ordinary light duty hand-controlled machine cycle, mechanical braking usually costs less.

In special machines where one or only a few machines of a kind are built, the cost of utilizing electrical equipment is often less than that incurred by utilizing mechanical controls, particularly in view of the extensive design work involved in developing the latter. For such cases, cost reduction through the use of electrical equipment is desirable. However, where machines are standard or where twenty or more will be built, the cost of designing is justified and the comparisons that have been made in this paper will apply.

These examples compare only cost differences between electrical, hydraulic, and mechanical drives. The electric drive, however, is so versatile that generally speaking any desired result can be obtained electrically. There are no "can't be done" applications for electric drives on machine tools. In many instances the advantages of the electric drive will

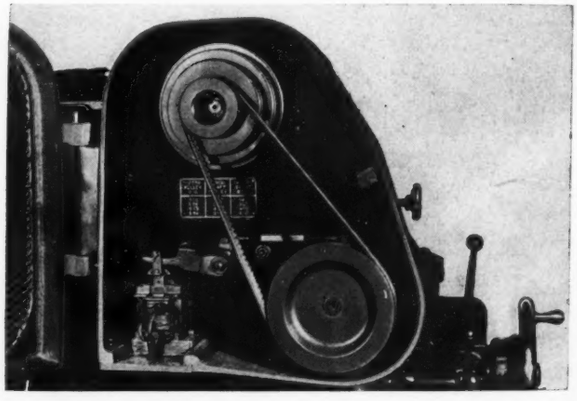


Fig. 2 — Above — Change pulley drive for speed changes between 145 and 600 r.p.m. Magnetic brake is at lower left

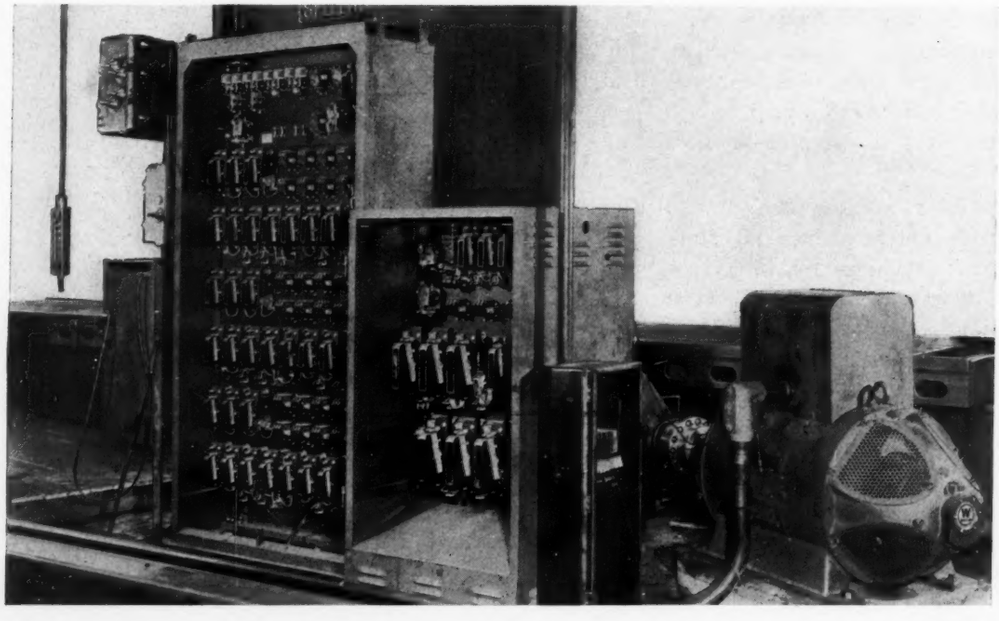


Fig. 1 — Left — This direct-current adjustable speed drive has advantages other than cost, in that its speed range is controllable between speeds of 20 and 1200 r.p.m.

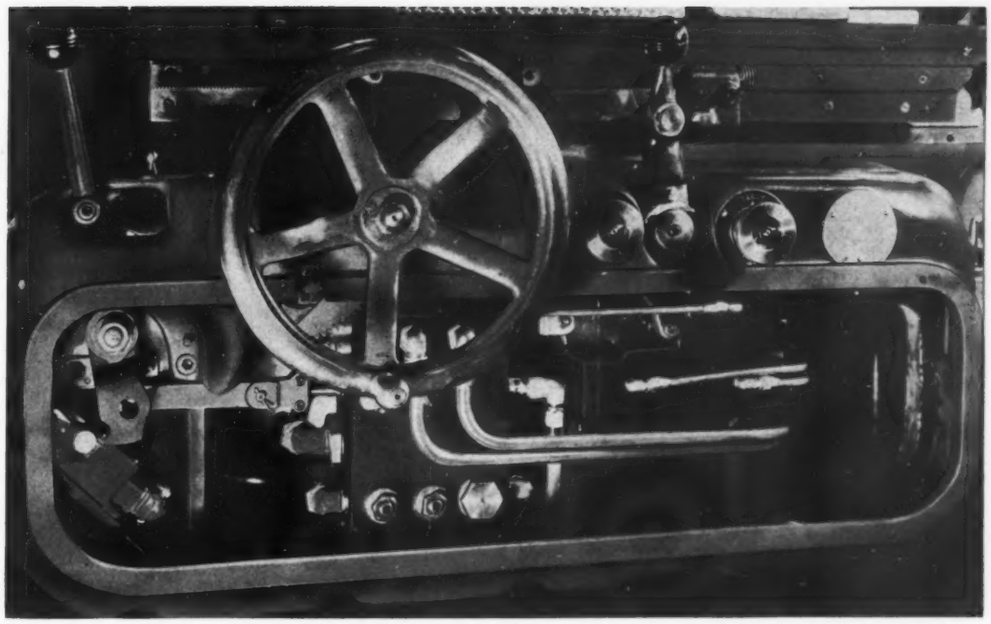


Fig. 3—Hydraulic reciprocating adjustable speed control for cylindrical grinder showing speed controls and reversing valves for traverse

outweigh any slight increase in cost over other types of drives. However, all other things being equal, hydraulic and mechanical drives will continue to be used where they show a cost advantage. Since the cost of these mechanical and hydraulic devices is continually being reduced, further reduction in cost of certain items of electrical equipment is desirable if electric drives are to attain their fullest possibilities on machine tools.

Simplification Effects Cost Reduction

REDUCTION in costs through simplification of design was discussed in another paper at the forum on machine tool electrification. Prepared by W. E. Happel, electrical engineer for Landis Tool Co., the paper shows how careful study of diagrams and machine functions makes possible noteworthy savings through redesign.

In many instances the justification of electrical equipment resolves into a matter of cost. Electrification is in direct competition with low cost mechanical and hydraulic mechanisms. If electrification costs are high it is usually because of conditions created by specifications and design. Engineers, attacking the problem with a process of investigation and elimination, can often simplify drives to the extent that substantial savings result.

Cost analysis of a semiautomatic machine disclosed that electrical equipment constituted a substantial part of the overall cost. As a result, a new control scheme was evolved, employing fewer control relays and eliminating one motor plugging control. Wiring was simplified. The final reduction in cost of the electrical equipment was $134 per machine. Mechanical equipment to the amount of $50 was also eliminated. In addition to the saving the machine is now easier to set up and adjust. General efficiency and value of the machine from the users' point of view was increased.

Another example involves a motor brake. It was decided to apply braking to the motor supplying power to a small machine. Production cost limits did not warrant the application of conventional standard plugging control or rectified alternating current dynamic braking, and a solenoid type mechanical brake could not be applied. The drive has to be free for occasional manual rotation in the reverse direction.

This problem was solved in the following manner: Two, three-pole, size one contactors, mechanically interlocked and less interwiring were obtainable at a reasonable cost. A simple, friction-type brake switch was designed and a control lever on the machine slightly altered to provide a "braking" position. A standard double-pole limit switch was substituted for the original single-pole switch for starting and stopping the motor. This arrangement incorporated all the features desired and proved a trouble-free and highly satisfactory brake for the headstock motor. In this instance the net cost of plug braking was reduced 50 per cent over "standard" equipment.

Three motors on still another machine were controlled by three across-the-line starters, separately mounted and interwired. A new control scheme was worked out whereby two of the three motors could be started from one contactor and protected by individual overload relays. The third motor was started and stopped by a maintained contact switch, thereby eliminating the usual pickup contact of a standard starter. Low voltage and overload protection was provided for all three motors. The machine now has a compact, built-in control with a saving of $16 per machine.

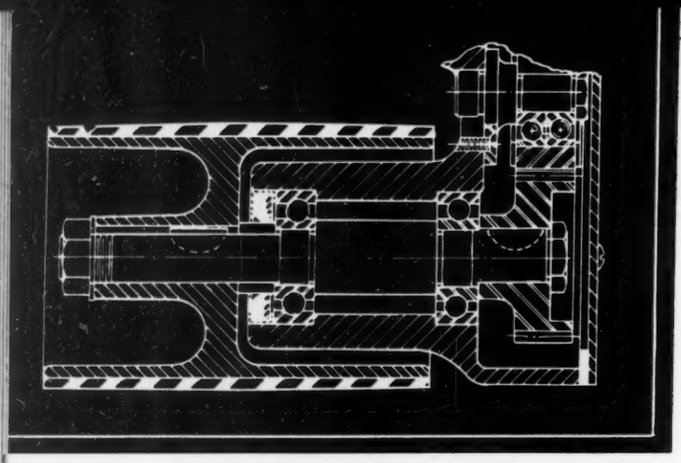


Fig. 1—Nonspring-loaded unit seal on a sander drive shaft retains lubricant, keeps out dirt

Selecting Seals

Part I—Unit Seals

By George Z. Griswold

HIGH speeds and light lubricants of modern machinery have imposed new demands on bearings. On the other hand, factors such as longer life, reduced maintenance, elimination of frequent oiling, quieter running and less friction are expected of all new machines. Properly selected and applied seals and packing can aid greatly in the achievement of these aims.

Stated briefly, the general purpose of seals—and packings—is to protect machine parts by preventing ingress or egress of liquids or foreign matter. Although characteristics and resistant properties of seals vary, the range of types affords the designer the opportunity of selecting the particular unit best suited to his requirements. These may be only the retention of lubricant or may include protection against water, chemicals, oil, etc.

Unit bearing seals—assembled and self-contained parts made for a variety of comparatively standard applications—will be discussed in this article, the first of a series covering types of seals and packings.

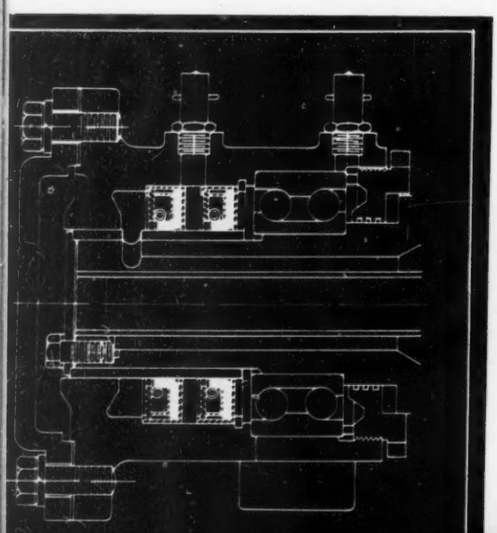


Fig. 2—Two or more seals are frequently mounted in tandem when substantial pressure at high speeds is present

One of the commonly used types of unit seal consists of a sheet metal outer retainer with a flexible packing member held in place and secured against rotation with the shaft by patented clamping or holding methods. These seals are available with springs to hold the packing in correct fluid-tight contact with the shaft, to take up or compensate for wear and to insure more positive "shaft follow" of the packing itself. Springs are usually of the contracting coil type, although the stamped or finger-type spring is also used in some seals. Naturally the type of seal, and whether or not a spring is included, depends on the character of the bearing and on the expected operating conditions.

Tough, flexible material capable of resisting the action of the spring—where used—without disintegration, makes up the packing members. Leather is still the most widely used material, but in recent years the oilproof synthetic or chloroprene rubber compounds have achieved increasing popularity. Leather from a physical or chemical standpoint shows little or no effect from exposure to mineral oils or greases, but is limited to packing applications where running temperatures do not exceed 200 to 250 degrees Fahr.

The synthetic materials used in seals can be depended on to function satisfactorily at temperatures up to 300 degrees. Choice of synthetic compounds is always indicated when the seal comes in contact with fluids incompatible with leather. Typical of these fluids are acids, alkalis, and low viscosity

...and Packings

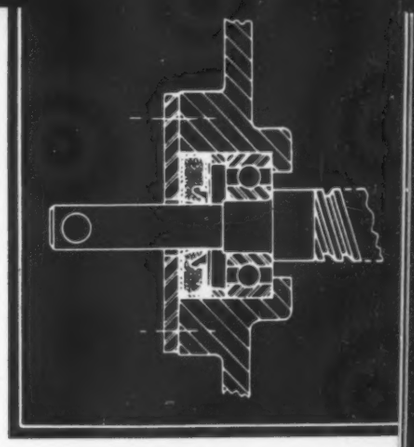


Fig. 4—In this application of a spring-loaded seal to a small wormshaft the seal is pressed into the same bore as the ball bearing

oils including ones such as kerosene and fuel oil.

Accelerated action on the flexible synthetics from the standpoint of change in physical characteristics takes place with the low viscosity fluids just mentioned, however. Synthetic compounds are capable of resisting higher static temperatures than leather but they are incapable of absorbing lubricant and redistributing it in a film between the seal and the

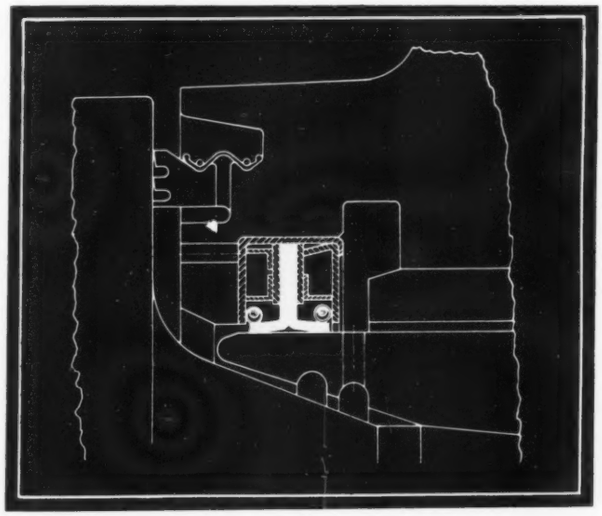


Fig. 3—Opposed seals in this double flange spring-loaded unit divide the duties of oil retention, dirt exclusion

shaft, which a leather sealing member does. The synthetics may thus create greater friction, and should not be expected to stand up merely because of their ability to resist higher temperatures. Whenever high rubbing speeds or other severe conditions are involved, the seal manufacturer should be consulted.

Seals and packings may be used to seal against a shaft or a housing. That is, they may be fastened to the shaft and run against a housing, or they may be fastened to the housing and permit the shaft to rotate inside. On machinery such as water pumps, for instance, seals may be attached to the rotor or fastened to the body of the pump and seal against the face of the rotor.

Certain facts should be kept in mind by the designer if he is to apply seals effectively. Grinding of all shafts is desirable. The disadvantage of an unground finish is that machining usually develops a spiral that may tend to pump the oil out under the seal. On rotating shafts eccentricity should never be over .003/.004-inch. Otherwise it is difficult to seal fluids and bearings and other parts of the mechanism may be affected. These troubles can be avoided through proper planning.

Seals should not be used on shafts having drive too far from the bearing, because of a possible whip which is apt to cause leakage in the seal. If it is necessary to cut keyways, grooves or splines on a shaft over which the seal must be pressed, these should be at a smaller diameter than that on which the seal operates, or the packing of the seal should be protected by a sleeve or other means while being installed.

In connection with the mounting of seals the designer should attempt to follow the limits on the press fits as given in the catalogs of seal manufacturers. The seal should be press fitted to the housing in such a manner that the unit is not mutilated or "sprung," by applying pressure smoothly and uniformly over the entire sheet metal face of the seal. Many seal users supplement the tight joint between the seal and housing bore by applying a light coat

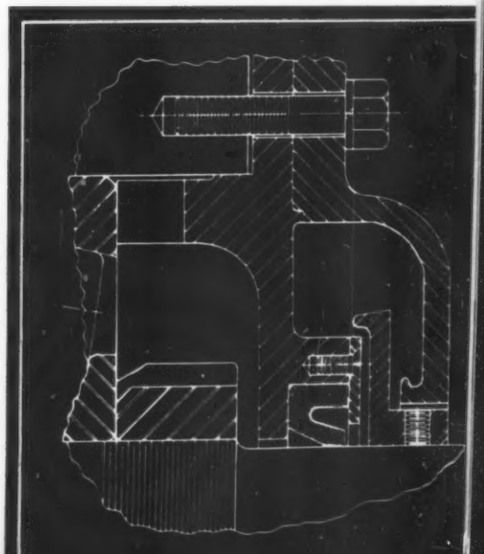


Fig. 5 — Modified type of seal shown in Fig. 4. This unit can be applied without dismantling the machine or removing shafts, bearings, or stripping gears

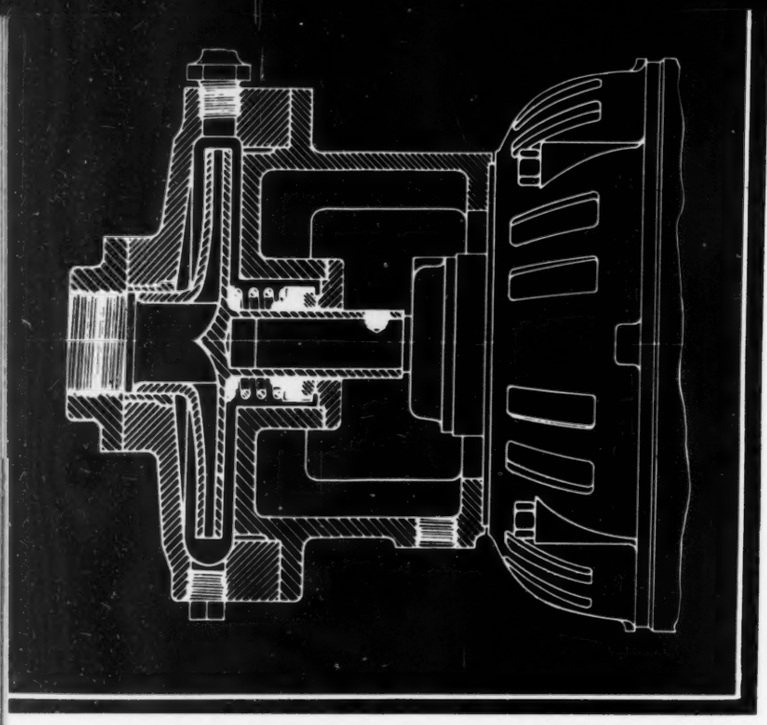


Fig. 6—Arrangement of parts and design details of this spring-loaded radial type seal depend on particular requirements of the application

of shellac or gasket cement to the retaining shell wall just before it is pressed into place.

Where there is a possibility of extreme pressure caused by foaming or gear action, it is wise to vent closed mechanisms so that pressure is not built up on the seals.

When selecting seals it is vitally necessary to consider the question of speeds involved. It is the rubbing speed of the rotating piece which is responsible for wear of the packing. In addition to this abrasive wearing effect, the packing member is subject to the high temperatures generated by friction.

Two thousand feet per minute rubbing speed is approximately the maximum for which standard type seals usually are recommended. At any speed exceeding 1000 feet per minute adequate lubrication of the packing must be assured. Seals are used successfully in many applications exceeding these speed limitations, but in all such cases careful study should be given the problem. Frequently a special sealing member is substituted or a spring change is made.

Seal Friction Adds to Heat

In regard to heat in any particular packing application, it should be borne in mind that the running temperature produced by the mechanism without seals is not the temperature at which that mechanism will run with seals operating in frictional relation with the shafts. Some temperature rise must be anticipated from this friction.

The amount of temperature rise that can be anticipated depends on so many influences beyond the control of the seal manufacturer that it is virtually impossible to furnish a set of hard and fast rules for this condition. Among these influences are the amount and type of lubricant used, speeds, type and adjustment of bearing, confinement of oil and air expansion within the mechanism, and others. The mere fact a mechanism has been properly sealed results in greater confinement of oil within the mechanism and influences temperature. It has been proved in some cases that lowering the oil level in a mechanism will reduce temperature rise. This is not to say, however, that the seal itself runs cooler with a scant amount of lubricant. In fact, a lubricant-starved seal is a dangerous pitfall. In the case of a seal operating in close proximity to a grease-packed bearing, the seal will probably receive sufficient lubricant for satisfactory operation up to 200

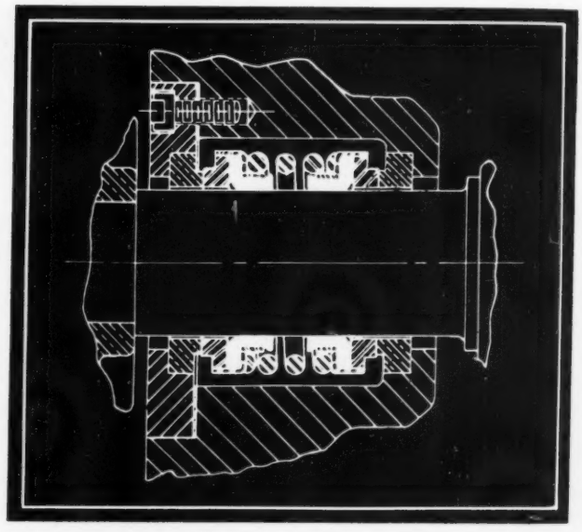


Fig. 7—This double seal design is often used when operating conditions make it necessary for the seal to function in an oil-filled chamber

or 300 feet per minute. Thereafter temperature rise will accelerate and other problems of friction will occur.

The widespread acceptance of unit type seals can be attributed largely to the following summarized features: General adaptability and ease of assembly; compactness; automatic take-up and self-adjustment (spring loaded type); uniform predetermined friction load; combined features of exclusion and retention; long, efficient sealing life; standardization and accessibility.

Fig. 1 shows a unit type nonspring-loaded seal on a sander pulley drive shaft of ¾-inch, where the lubricant is not only retained, but dust, dirt and other foreign matter are prevented from entering. This application is noteworthy because it uses a conventional single type seal to perform a dual function. Axial as well as radial cross section is only ¼-inch. In this connection the majority of rotating shaft packing problems can be satisfied with unit seals having axial and radial cross section

space requirements of from ⅜-inch in the small sizes up to 1 inch for the very large shafts, rods or hubs. Shafts from 5/16-inch to 48-inch diameter can be sealed effectively.

Moderate pressures up to about five pounds can be held by single unit seals, provided shaft or rod speed is moderate, or up to 200 feet per minute. But when substantial pressure, particularly at higher speeds, is present, two or more seals commonly are mounted in tandem with the sealing edges directed toward the pressure. *Fig.* 2 shows unit type seals applied in this way to protect a bearing in a water-cooled brake assembly of a draw works. Pressure in this instance is 120 pounds, at an intermittent speed of 500 feet per minute. Seals are spaced to permit pressure lubrication between sealing members. Entrance of mud and water is prevented and the discharge fluid is separated from the cool intake fluid.

Dual or combination unit seals incorporate the same simplicity of design and assembly and are available in several types. In *Fig.* 3 a double flange spring-loaded unit confines the oil and excludes water and mill scale from a totally enclosed roll neck sleeve bearing. The opposed seals divide the duties of retention and exclusion. In contrast with the ¾-inch shaft in *Fig.* 1, this application is on a 42-inch collar.

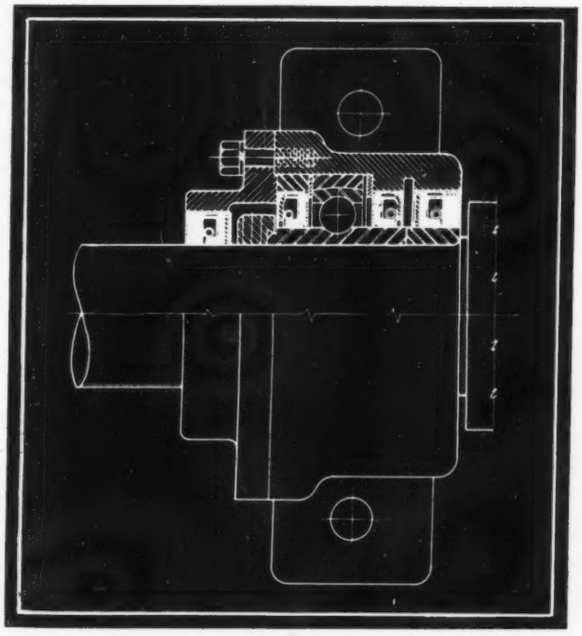


Fig. 8—Usually applied opposed to the felt, this combination spring-loaded seal with felt packing is here positioned in the same direction

Although radial and axial space requirements of unit seals are comparatively small, a word should be said about this factor in heavier equipment where pressure is present, as illustrated by *Fig.* 3. In a sense the spring has only a complementary function in cases of this nature. The tapered barrel or neck of the inner packing must have both flexibility and a natural tendency to resist permanent set. If the axial space allowed is too limited it requires prohibitive shortening of the neck or barrel of the packing, curtailing its natural action.

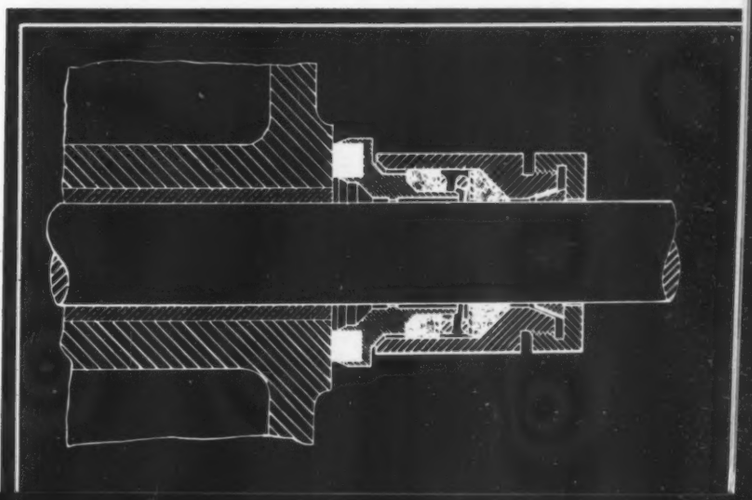
Standard widths set up by seal manufacturers have been selected to assure a smooth shaft contact with the correct action of the packing which will act immediately by virtue of the complementary encompassing effect of the spring. This action must be built into the unit if it is to seal rotating as well as reciprocating shafts, and it is doubly important if the surface or rubbing speed is high. Where deviation from the manufacturer's space standards seems necessary it is wise to seek engineering consultation before reaching a final decision in the matter.

Bearing Preload Includes Seal Load

Frequently it is necessary to predetermine the friction load of a seal so that the preload on roller type bearings can be set up to include seal friction. If the designer is given the starting load of the seal in inch-pounds, the constantly lowered resistance factor to be encountered during the run-in period and the final leveled-off friction at which the seal can be expected to run indefinitely thereafter, he can easily set up his bearing preload specifications. Hence when preloaded bearings are involved, the advantage of the predetermined tension spring-loaded seal is readily apparent.

Fig. 4 illustrates the application of a seal to the end of a small wormshaft employing single row ball bearings. A lug or finger type spring nests into the sealing ring, of special shape and composition. This spring applies uniform pressure at all points around the shaft and holds the sealing lip in intimate contact with it. The shaft design is unusual because it employs a seal that is pressed into the same bore that receives the ball bearing. Considerable saving in tool setup, machining costs and assembly is realized in this way. End thrust in this design is

Fig. 9—Shaft metal rotates against an antifriction insert in the nose piece of this seal, which is centered loosely around the shaft and takes up end play



transmitted through the spacer and seal to the fixed plate bolted to the outside of the housing. This seal is also frequently used with a sleeve bearing, in which case a return oil drain is provided between the sleeve and bearing to guard against pressure.

A modified type of the same seal, with a beryllium-copper spring in this particular case, is applied in *Fig.* 5, the bottom press roll of a large paper machine. Its purpose is to retain lubricant in a roller bearing and to exclude pulp and water. This seal, being split, can be applied without dismantling the machine, and precludes the necessity of removing shafts and bearings or of stripping gears, pulleys or flywheels from a shaft. It is placed around the shaft at a point near the seal recess and is then clamped into the recess with a cover plate.

The unit seal in *Fig.* 6 differs in several respects from the seals discussed thus far. It is a unit depending on the particular requirements of virtually every application for the arrangement of its parts, the design details, and the sealing materials.

Briefly, the seal is a spring-loaded radial type in which the flexibility necessary to compensate for any slight angular or lateral shaft movement is obtained by a flexible connection between the shaft and the seal face. "Radial" type means that contact is maintained between two surfaces perpendicular to the shaft axis, one stationary and the other turning with the shaft. The flexible connection between the shaft and the seal face, amounting to an L-shaped ring of a neoprene or other rubber-like compound, also acts as the drive for the complete assembly.

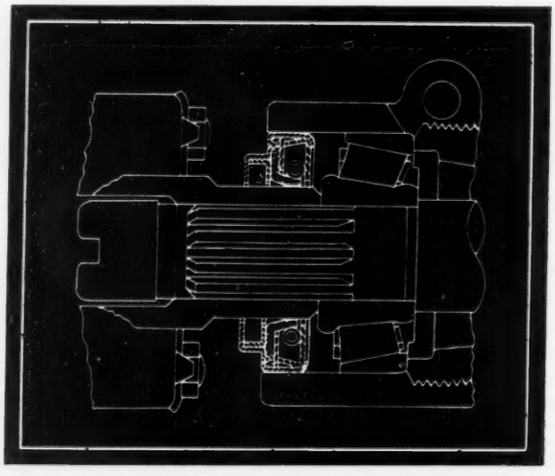


Fig. 10—An additional compartment of packing has been added to this unit seal because of the severe operating condition

The application in *Fig.* 6 is a common type, with the seal assembly mounted directly on the shaft, in a rotary pump housing. Material for the seal face is either hardened steel or a special carbon, depending on the substance being sealed against. The stationary seat, amounting to a flat surface on the gland or cover plate, is of whatever material provides the most suitable bearing combination with the particular seal face material. Brass retainers and a stainless steel spring are used for corrosion resistance.

Fig. 7 shows a double seal arrangement often used when it is desirable to keep the substance being handled from coming in contact with the seal parts, or where because of operating conditions it is desirable to have the seal function in an oil-filled chamber. The seal faces are usually hardened steel and the mating stationary seats bearing bronze.

A type of seal requiring less axial space than the double flange type in *Fig.* 3 is the combination spring-loaded seal with felt packing, shown in *Fig.* 8. This type is usually applied with the packing directed toward the lubricant to be sealed within the mechanism, and the felt is positioned to act as the exclusion element. The example in *Fig.* 8 is unusual in that the spring-loaded packing and the felt are not opposed but are both directed toward exclusion.

Shaft Metal Rotates Against Insert

Basic principle of the seal in *Fig.* 9 is rotation of the shaft metal against an antifriction insert of microfine graphite mounted in the nose piece of the seal. The nose piece centers itself loosely around the shaft. Flexible packing rings between the nose and the stuffing box adapter or chamber wall seal the nose piece against the body of the machine. Packing rings are held in expansion by a compression ring as illustrated. The combination of the flexible packing rings under compression permits movement of the nose piece of the seal to take up end play and misalignment. In design this seal can be made either balanced against pressure or out of balance to take advantage of a pressure or vacuum. *Fig.* 9 shows an outboard arrangement of the seal which is enclosed in a casing clamped to and rotating with the shaft.

Under severe conditions, such as illustrated by a pinion shaft on the rear axle of an automobile, a unit seal of the type in *Fig.* 10 is often used. Ordinarily this seal is composed of a flange leather packing, a compression washer, two telescoping steel cups, and a garter spring. The combination type in the drawing also has an additional compartment containing a packing made of felt, leather or composition. Best results with this seal are obtained as shown, with the sharp edge of the leather toward the oil. In designs where the shaft is assembled through the packing face of the seal, care must be taken to avoid folding the edge of leather back. A shaft chamfer usually eliminates this trouble.

The editors wish to thank the following companies for their kind co-operation in the preparation of material and illustrations in this article: American Felt Co.; Chicago Rawhide Mfg. Co. (*Figs.* 1, 2, 3, 8); The Garlock Packing Co. (*Figs.* 4, 5); Rotary Seal Co. (*Figs.* 6, 7); Syntron Co. (*Fig.* 9); Universal Oil-Seal Co. (*Fig.* 10); and Victor Mfg. & Gasket Co.

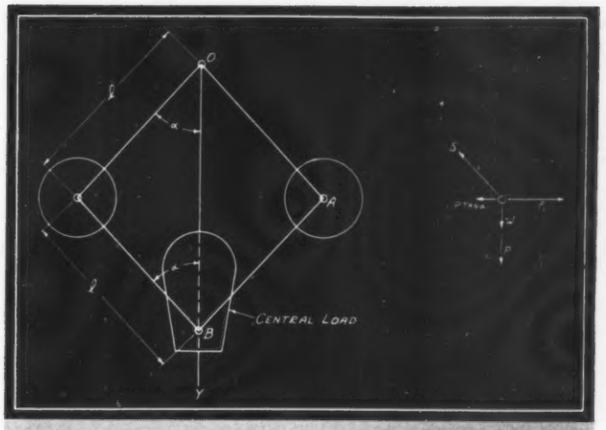
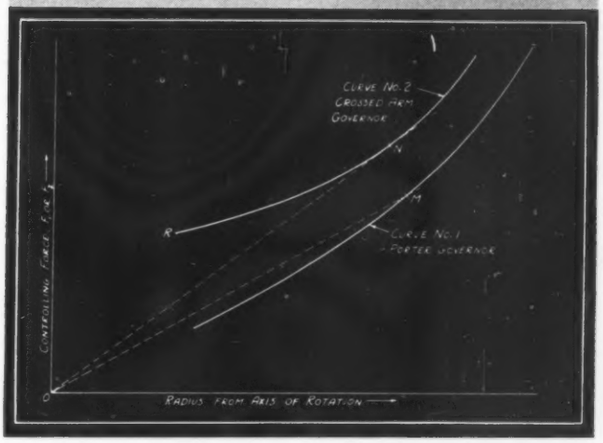


Fig. 1 — Right — Centrally loaded flyball governor. Insert shows free body diagram of forces acting on ball. Fig. 2—Below—Curves show stability of flyball governors

Graphs Aid in Governor Design



By R. C. Binder

WHEN analyzing flyball governors for speed control systems, graphical representations are often found useful and aid in determining the most suitable design. The stability of a governor may be studied by a conventional method usually given in reference books on the subject. There is, however, another method which brings out certain features in a simple, convenient manner. These two methods will be illustrated by a comparison of a centrally loaded, or Porter governor, and a crossed arm governor. A brief discussion of the relations involved helps in understanding the graphical representations.

The controlling force in a governor may be considered as the centripetal force which acts on a ball in a direction toward, and normal to, the axis of rotation. For stability the controlling force must increase at a greater rate than the radius as the balls move outward. Referring to *Fig.* 1, the controlling force for the equilibrium position is

$$F_1 = \frac{W}{g}\omega^2 l \sin \alpha \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (1)$$

where W/g is the mass of a ball, and ω is the angular speed of rotation.

Curve 1 in *Fig.* 2 shows a representative plot of the force F_1 against the radius from the axis of rotation (radius $= l \sin \alpha$). The governor is stable, all points along curve 1 having a slope greater than the slope of a line drawn from the point to the origin. For example, the slope of the curve at point M is greater than the slope of the dotted line OM.

For crossed arm governors as shown in *Fig.* 3, the controlling force is

$$F_2 = \frac{W}{g}\omega^2 (l \sin \alpha - x) \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (2)$$

Curve 2, *Fig.* 2, shows F_2 plotted against the radius (radius $= l \sin \alpha - x$). Between R and N the slope of the curve at any point is less than that of a line drawn from the origin, and the governor is unstable.

Stability can be illustrated in another manner by plotting the angular speed against the angular position α. Equations used to plot this relation will be given first.

In *Fig.* 1 is shown a free body diagram with the

forces acting on one ball. P represents the central load per ball. F_1 represents the inertia force which is equal and opposite to the controlling force. S is the tension in the link OA, while the tension in the link AB has been resolved into the components P

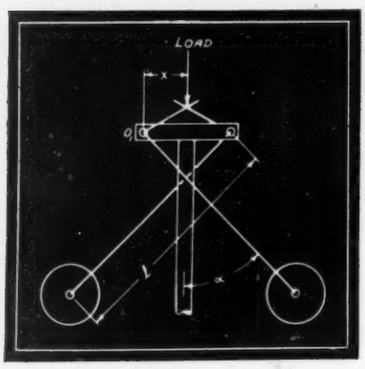


Fig. 3—Diagram of crossed arm governor showing symbols for analyzing its action

and $P(\tan \alpha)$. Taking moments about point O gives, for the Porter governor

$$l \sin \alpha (W+P) + P \tan \alpha \, l \cos \alpha = F_1 l \cos \alpha = \frac{W}{g} \omega^2 l^2 \sin \alpha \cos \alpha \quad \ldots\ldots\ldots\ldots\ldots\ldots (3)$$

Referring to *Fig.* 3, and taking moments about point O_1 gives, for the crossed arm governor

$$Px + W l \sin \alpha = F_2 l \cos \alpha = \frac{W}{g} \omega^2 (l \sin \alpha - x) l \cos \alpha \quad \ldots\ldots\ldots\ldots\ldots\ldots (4)$$

Curve 3 of *Fig.* 4 shows a plot of rotational speed ω against the angular position α, if definite values are given to the factors l, W, and P in Equation (3). Curve 3 has a positive slope for all points and the governor is stable. An increase in speed indicates

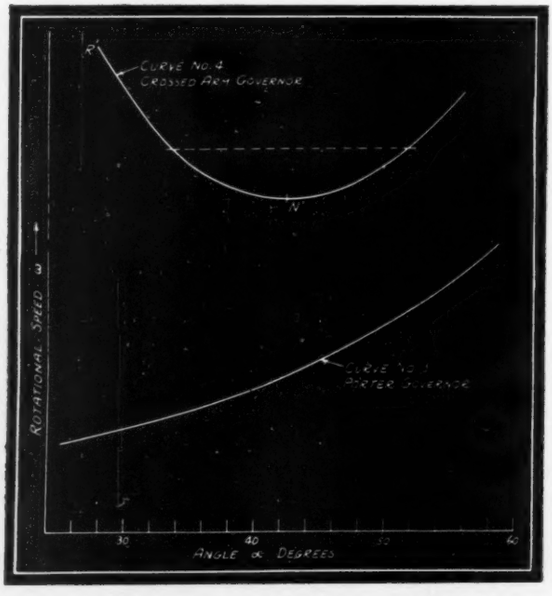


Fig. 4—Sensitiveness and stability of the two types of governors are compared

a larger radius and therefore a larger value of the angle α. Curve 4 shows a similar plot for a crossed arm governor. Between points R' and N' the slope is negative, the governor is unstable. A decrease in angular speed indicates a larger radius. Point N' on curve 4 corresponds to point N on curve 2, *Fig.* 2. The dotted line in *Fig.* 4 indicates two different calculated angular positions for the same rotational speed.

The slope of the curves in *Fig.* 4 gives a measure of the sensitiveness of the governor. The sensitiveness of the Porter governor changes to some extent over the range shown, while the sensitiveness of the crossed arm governor varies considerably. At point N' the governor is infinitely sensitive, and is termed isochronous. Point N' may be found by application of elementary calculus. The minimum point can be found by setting the first derivative of the equation equal to zero.

Curves of the type shown in *Fig.* 4 can be drawn for different tentative designs, for different values of the central load, weight of ball and arm length. Such curves give the designer a convenient comparison of characteristics and aid in reaching a decision as to the most suitable design.

Recent Research Publications

Fatigue Tests of Butt Welds in Structural Steel Plates, by Wilbur M. Wilson and Arthur B. Wilder. These tests were made on plates ¾-inch thick and from 5½ inches to 6 inches wide at the middle where the weld occurred. For one series of 21 specimens the plates were carbon steel, for a second series of six specimens they were silicon steel. The fatigue strength of the welded joints was arbitrarily taken as the maximum stress to which a specimen can be subjected two million times without failure. Published by the Engineering Experiment station, University of Illinois, Urbana, Ill.

Analysis of Mechanical Action of Synchronizers in Automobile Gear Transmissions, by Prof. George B. Upton, Sibley School of Mechanical Engineering, Cornell university. Showing the type of analytical work automotive engineers perform in connection with every detail of the vehicles, Prof. Upton first discusses the problems of shifting gears without special synchronizing devices. In "up-shifts," as from low to second or second to high, the oil in the transmission tends to aid synchronizing, since it slows the speed of the engine clutch. In "down-shifts," however, the engine clutch needs to be speeded up. Synchronizers, says Prof. Upton, have "balking elements," which prevent gear meshing, either on up or down-shifts, until mesh is silent. Published by Cornell University Engineering Experiment station, Ithaca, N. Y.

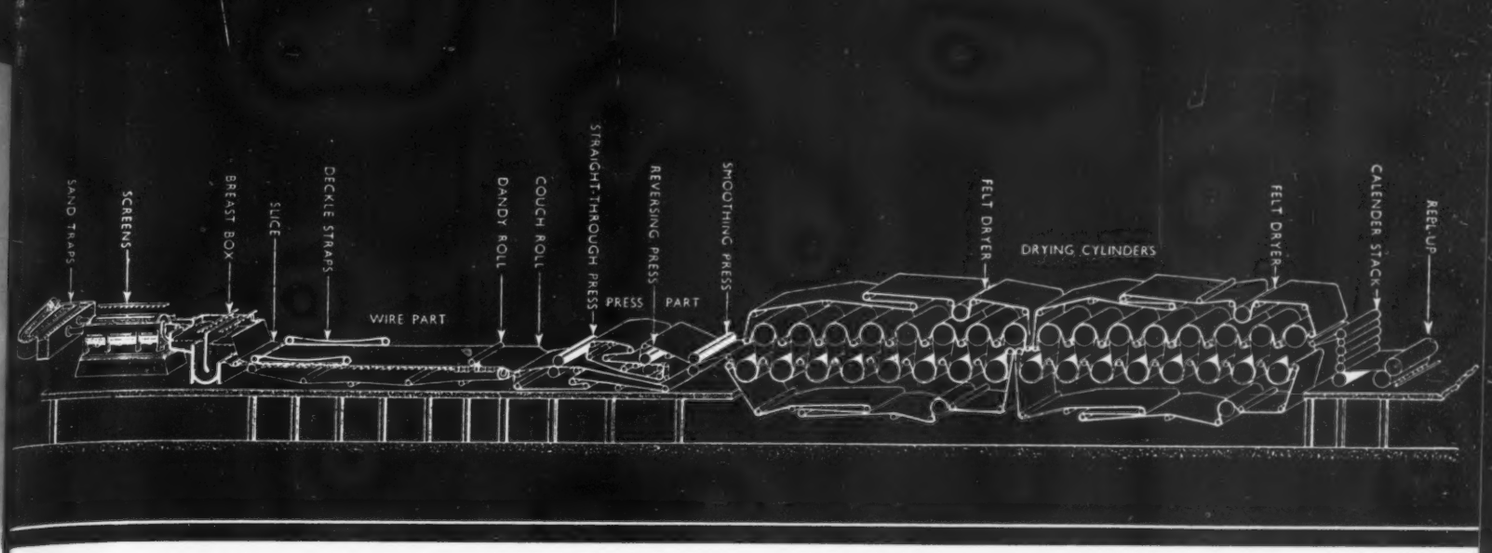


Fig. 1—Isometric view of Fourdrinier type paper making machine showing parts in relation to each other

Speed of Paper Machinery Increased by Vacuum Process

INCREASED widths and speeds of paper machines have necessitated the adoption of many devices which previously had been looked on with doubt. A number of such improvements were touched upon by W. H. Orr, director, E. S. & A. Robinson Ltd., Bristol, England, in a paper presented before a recent meeting of the Institution of Mechanical Engineers. High spots of the paper, relative to design, are given in the following brief abstract.

Referring to *Fig.* 1, when the web of paper passes from the couch roll to the first press it is slightly elongated in the machine direction. If the path of the web is to remain constant, and is not to be lengthened due to the stretch of the web, then the first press felt must run slightly faster than the wire and the relative speeds must be kept constant. Exactly the same conditions apply between the first and second presses and every subsequent one, as well as between the last felt and dryers, dryers and calenders, and calenders and reel-up. Each section thus must have a peripheral speed slightly greater than the preceding one.

Controls Relative Speed

To permit the speed of each section motor to be varied relatively to any other section the position of the belt on the cone pulleys, *Fig.* 2, coupling the section motor and the outer member of the regulating motor, can be varied; the position of the belt determines the relative speed of the section motor and its regulating motor. If an increase of "draw" is required between, say, the first press section and the wire section, the belt coupling the section motor to the regulating motor of the first press is moved in such a direction as to decrease the speed of the outer member of the regulating motor. The inner member will then commence to rotate and will increase the speed of the driving motor of the first press section until the outer member of the regulating motor is again rotating at a speed equal and opposite to its field. The field of the regulating motor will again be stationary in space; the brushes of the section driving motor will have been moved, thus altering its speed.

Position of the belt on the cone pulleys is determined

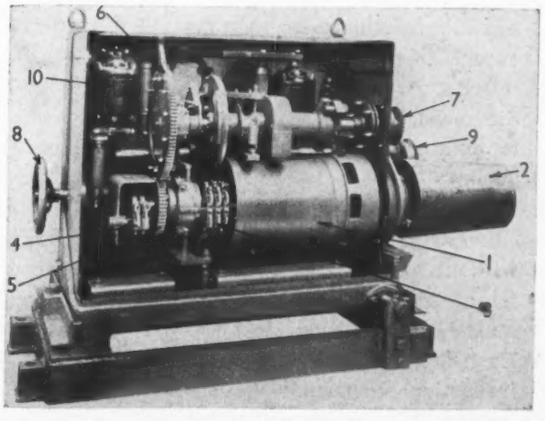


Fig. 2—Speed regulating gear with cover removed

by a guide controlled by a handwheel at the back of the machine or by a pilot motor pushbutton operated from the front. In the illustration is shown the regulating gear with cover removed. The outer member of the regulating motor has an extended shaft carrying the cone pulley. Slip rings of the outer and inner members are shown at (3) and (4) respectively. A pinion is fitted to inner member gears with wheel which is carried on a shaft above. At its other extremity this shaft carries a sprocket from which a chain drive is taken to the section motor brush-operating gear. Handwheel operates the leadscrew for moving guide pulley to alter the position of the belt and give "draw" adjustment. The pilot motor which gives remote control of the draw adjustment operates through a worm on to the shaft carrying the handwheel.

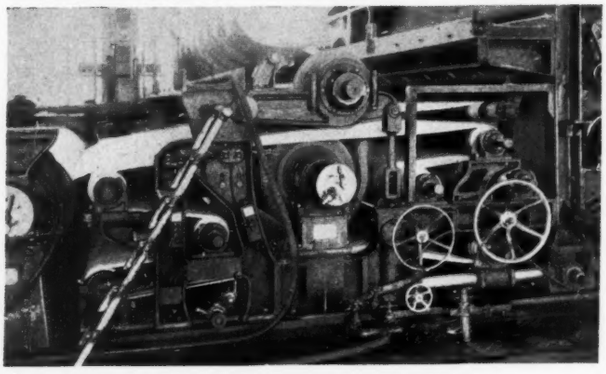


Fig. 3—Suction press showing paper passing from couch roll to press felt

Drive Requirements

Paper machine drives should conform to the following requirements:

1. Each section of the machine must be positively driven
2. Each section must be capable of accelerating and running at any speed within the specified range
3. Each section must maintain its speed constant, relative to the other sections when they have once been set
4. It must be possible to alter quickly and easily the speed relationship between any two sections to obtain correct "draw," that is, pull on the paper
5. It must be possible to alter the speed of the machine as a whole right through the speed range without altering the relative speeds of the different sections, and whatever speed is selected must be held steady
6. Each section must be capable of "crawling" for inspection purposes.

Requirement 3 is the important one and, as discussed, considerable ingenuity has been displayed in obtaining it. Failure in this respect causes breaks and reduces production.

Suction Presses Conserve Space

In these days of mass production, paper mills equipped with old machines are finding it difficult to meet competition. Often these machines are housed in buildings where it is impossible to increase the output by adding more drying cylinders. Use of suction presses has done much toward increasing capacity. Replacement of three plain presses by two suction presses often enables two or four dryers to be added and also produces a drier sheet at increased speed.

Suction press rolls have many advantages over plain presses. It is doubtful if the speeds at which newsprint and wrapping papers are made today would have been possible without them. With them the paper breaks less often, water pools are eliminated from the nip of the rolls as the water pressed from the sheet escapes through the perforated shell, and nip pressure is generally 70 to 100 pounds per lineal inch against 150 to 200 pounds on a plain press. Thus there is less displacement of fibers, less crushing with consequent fewer breaks and longer felt life.

In *Fig.* 3 is illustrated a suction press where the wire side of the sheet is in contact with the felt while the top side of the sheet is pressed by a smooth granite roll.

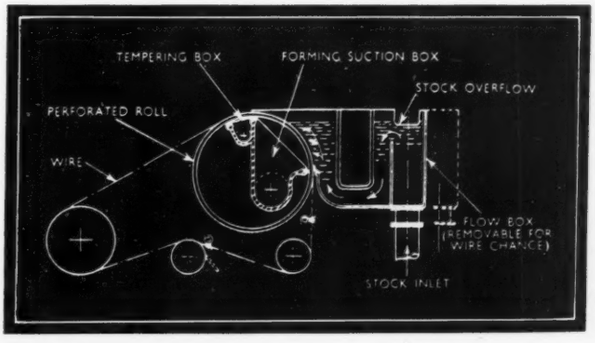


Fig. 3—Dual press showing horizontal arrangement of rolls employing suction press followed by plain press

An arrangement known as stacked suction presses is compact, being the equivalent of two presses in the space of one plain or one suction press. In another combination of presses usually referred to as dual presses, the rolls are stacked horizontally. There are many possible combinations; for example a center rubber-covered roll can be used with bronze suction rolls on either side, or a first suction press with a bronze roll and a second press with a plain granite roll. Similarly, a center granite roll can be used with rubber-covered suction rolls on either side.

Where the second nip is arranged as a plain press,

this can be felted or unfelted, using it in the latter case as a smoothing press. There are a number of these arrangements operating on a wide range of papers. Dual presses usually allow installation of additional dryers as do stacked presses. Similarly, any draw between the presses is eliminated. Usually the two outside rolls are commanded from separate sections of the drive.

Vacuum Forming Increases Capacity

One of the most revolutionary proposals for forming a sheet of paper is vacuum forming wet end. This machine was conceived by Millspaugh, who built a machine with three forming rolls having a width of 60 inches operating on this principle. The machine was equipped with other revolutionary ideas including a stacked press. This machine operated satisfactorily on a wide variety of paper and boards, from duplex newsprint to roofing felts. Newsprint was made at a speed of 800 feet per minute and increased to 1000 feet per minute.

Fig. 4 shows diagrammatically a single roll vacuum forming machine and gives an idea of its compact layout. Increased strength of sheet is obtained through accurate control of moisture content and agitation of stock in vicinity of forming roll.

The essential part of the machine is a centrifugally cast perforated bronze shell or forming roll, 36 to 44-inch diameter, over which is placed a short wire. The flow box has curved deckle plates fitted close to the wire and adjustable to suit the width of sheet. Vacuum forming roll has a vacuum box similar to a suction couch roll except that two compartments divide the box. The first and larger compartment is called the forming box and the second, the tempering box. These boxes are operated from separate vacuum systems, the latter working at a higher vacuum than the former. As the forming roll rotates, carrying the wire with it, the water drains from the stock. Fibers are deposited on the wire and formation of the sheet is induced by vacuum, allowing rapid formation to take place. It then passes over the tempering box where the sheet is consolidated and, should the machine be equipped with several forming rolls, the moisture content is controlled so that the web is in a proper state for good bonding. Generally the web is picked from the wire by a suction transfer roll or a transfer box in a suction press roll. Such a machine having one forming roll is being used for making asbestos and roofing felt.

Several installations of Minton vacuum dryers for drying sheet material continuously under vacuum are at work producing newsprint and are dealing with pulp to make sized paper. Such a unit takes up less space and operates with better thermal efficiency than dryer stacks, the savings in space and thermal efficiency being dependent on the vacuum maintained. The lower the vacuum, the smaller will be the quantity of cooling water required for the condenser. These dryers usually operate with a vacuum of 28 inches of mercury. Increased strength of paper is obtained at the lower temperature, about 100 degrees Fahr., at which drying is carried out. Solvent sizing produces a better sheet in conjunction with Minton dryers than can be obtained with conventional dryer stacks.

Possibly the near future will see a paper machine with a vacuum forming wet end and Minton dryers, taking up less than half the space of the machines of today and perhaps enabling some of the older mills to increase their competitive power without incurring the expense of new buildings.

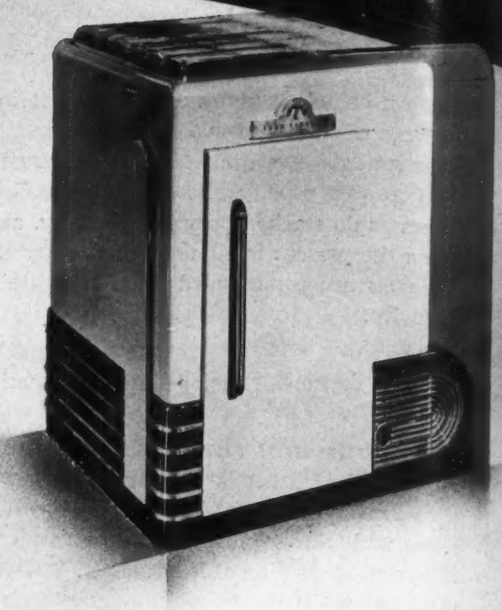
Portable X-Ray Camera Aids Flaw Detection

TO DETECT flaws in structural welds and heavy castings on production lines, a 220-kilovolt portable X-ray flaw detector has been placed in service by Westinghouse. The technique of radiographic diagnosis of large steel parts is expected to be much simplified by this 4500-pound portable X-ray camera, since it may be wheeled along production lines to maintain the quality of machines during their manufacture.

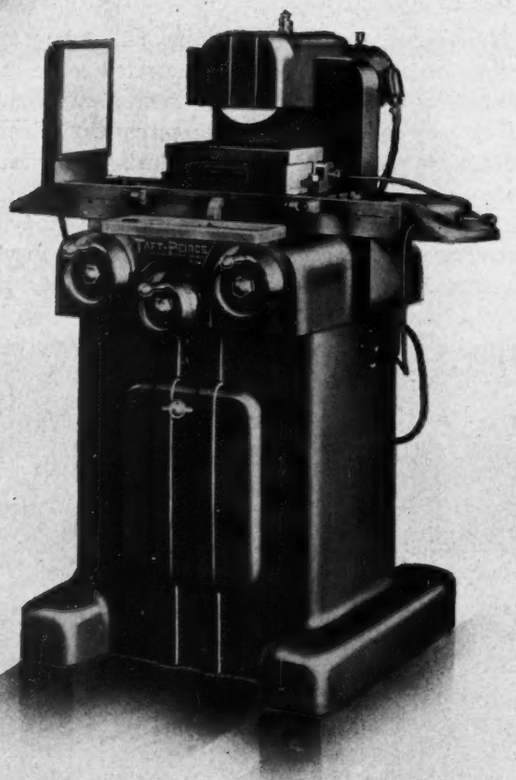
Shockproof, completely self-contained, ready for work wherever there is a proper supply, the machine generates X-rays with a penetrating quality sufficient for them to pass through three inches of solid steel. The focusing mechanism is extremely flexible, so that the apparatus may be aimed at a weld or casting in either a horizontal or vertical position.

X-ray tube, transformer, capacitors, and flexible focusing device are all mounted on a chassis with four balloon tires, automobile springs, and two-wheel mechanical brakes, enabling two men to move the apparatus with safety.

The Iron Fireman unit heatmaker (right) is a combination automatic coal burner, forced circulator, and humidifier. An ash receptacle is installed inside the fire door, where it is sealed from circulated air. A dust-tight hopper lid with a rubber seal is also used. Overload protection is provided by the shear-pin method



Indicating head of the Michigan Tool involute checker (left) checks gears from a pitch diameter, using a master rack tooth touching the gear tooth instead of a pointer. The sine bar is mounted on a carriage moved by a lead screw. For rapid setup of different lengths of gears and arbors, a single eccentric clamp is provided on the tail stock. The checker is provided with a full master base circle integral with the work-holding spindle, providing greater accuracy, better balance



Ball tracks of hardened alloy tool steel to guide the table, saddle and spindle column are provided in the Taft-Peirce surface grinder (left). A unique mounting of the wheel spindle permits it to swivel in a vertical plane about the wheel center, simplifying setup and adjustment. Starting and stopping of the spindle is controlled by pushbutton. The entire machine is mounted on rubber

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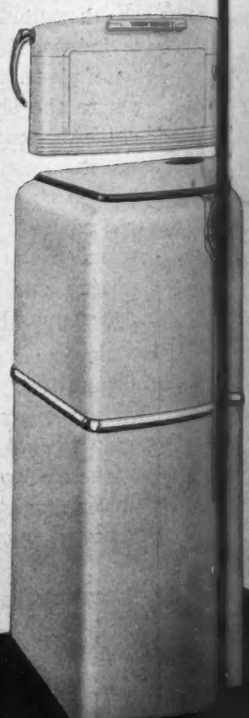
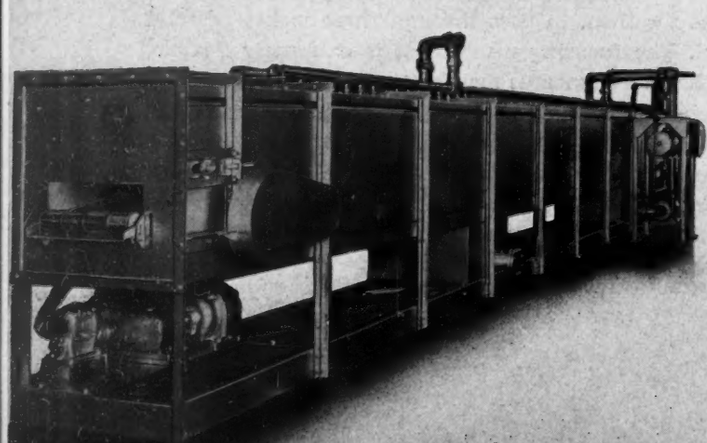


Heavy gage steel cabinet of the Altorfer 400 washer (right) is electrically welded and fully encloses the motor and main gearcase drive mechanism, which is held rigidly in place by an electrically welded integral bracing construction. Cover is galvannealed sheet steel, vibration-proofed with a rubber edge. Clock-type dial and time control indicator enable operator to control all washing action automatically. Motor is ¼-horsepower, rubber-mounted



A stainless steel housing envelopes the Thermal Thermo-Roto machine (left) for processing or pasteurizing fruit juices in cans. Rollers on an endless chain inside the housing move cans forward and rotate them simultaneously, linear and rotative speeds being controlled through separate driving mechanisms

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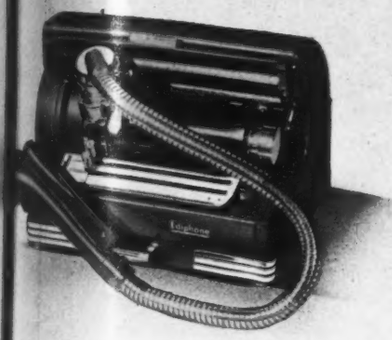
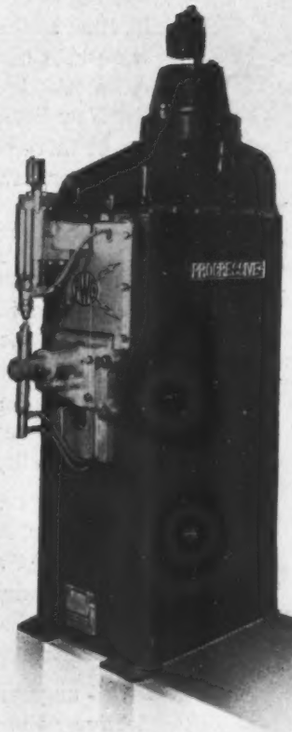


Light weight is attained in the desk Ediphone (left) by using aluminum for the top plate from which the motor is hung, as well as for the recorder mechanism plates. A flashing light in a molded plastic receiver warns when the operating lever is in the wrong position. Warm gray color, in automobile-type finish, was selected because research showed it harmonized with colors in any office. Handles and trim are chromium

Sturdiness of the Lake Erie acraplate vulcanizer is emphasized by enclosing the base, containing an hydraulic power unit in sheet steel, with side plates of heavy rolled steel (right). Controls have been allocated with a view to facilitating operation, and work is illuminated by a light incorporated in the projection over the gages. Lawrence Blazey was consultant on the clean cut exterior



A new design of welding head embodying a sliding contact is the basis for the Progressive spot welder (right). Use of solid arms and availability of nonmagnetic head contribute to current consumption reduction. Heat selection and timing controls may be either locked in the back or mounted externally for rapid adjustment. A gasket-sealed aluminum faceplate prevents scale and dust from being drawn back into transformer windings. Positive check on water cooling circuits is provided by overflow tubes

All-steel welded frame of the Oilgear horizontal broaching machine (right) supports the trough, cylinder, pump, motor and coolant pump, and encloses these mechanisms. A two-way variable displacement fluid power pump with solenoid-operated pilot control is arranged for direct drive. Ease of operation and control is provided by a simple dual pushbutton control and toe lever switch with emergency stop button. Two adjustable dogs with needle bearing rollers are on a rotary acting control rod in the broach trough, assuring maximum production

World's Fairs, Not War, May Initiate Turning Point in Business

IT IS being said that the New York World's Fair will create a ten-billion stimulant to business. From the standpoint of the engineer responsible for design of machines this is an effective tribute because, from first to last, the fair and its exhibits, the improved transportation facilities and all allied activities can be traced directly or indirectly to the work of the machine designer. And the same thing is evident, though on somewhat smaller scale, at the International Exposition at San Francisco.

Some of the most remarkable achievements of modern times are on exhibition at the fairs, including types of machines too numerous to mention which were held back by machinery manufacturers to make their debut at this time more effective. Among the most popular types of equipment to be exploited at the New York Fair are the new television units, development of which may well result in the establishment of a new industry or the complete revitalization of radio companies—a noteworthy asset to the country at a period when needed most.

Other stimulants are apparent on every hand. Assuming an attendance record of many million persons at the fairs it seems clearly evident that a vast number of ideas will be taken back to homes and businesses and given free play. On the basis of, say, fifty million attendance, only one person in ten need take away a thought or idea—and turn it into action—to make a severe "dent" in the too well established depression. The actual size of the dent will, of course, be influenced directly by the receptiveness of those able to make the trip, including designers and potential purchasers, to one or both of the fairs.

There's no comparison between a possible rejuvenation of business as created by peaceful factors such as indicated in the foregoing, with an upswing in industry brought about by a possible outbreak of war in Europe. Designers of machinery cannot afford to close their eyes to that possibility, but still can lay major emphasis on the development of peace-time equipment as influenced by the widespread effect of the fairs.

For years there will be no better places than these expositions to study collectively the trends in research, design and development, and to apply the ideas thus gained to the improvement and salability of machines. Alert machinery manufacturers are recognizing this fact and doing everything within their power to make attendance possible.

Professional Viewpoints

MACHINE DESIGN WELCOMES LETTERS SUITABLE FOR PUBLICATION

Wahl Calculations Ratified

To the Editor:

HAVING read Dr. Wahl's excellent presentation of recent work on disk springs, both theoretical and practical, I would like to add a few comments which may be of interest.

Since the publication of the paper by Almen and Laszlo[1] on uniform section springs, Lehr and Granacher in Germany published the results of their stress measurements on a Belleville spring, executed with a special strain gage of 2-millimeter gage distance, permitting more accurate measurements than hitherto possible.[2] It is interesting to repeat here the stress measurements at various points on the surface of the spring and compare them with the calculated stresses as computed first with equations given in reference (1), second with those computed with the aid of the flat plate theory. As the equations given in (1) do not consider the radial stresses, only tangential stresses will be compared below.

Distance from inner edge (millimeters)	Measured Stress lb. sq. in.	Calculated using (1) lb. sq. in.	Calculated using flat plate theory lb. sq. in.
0	70,500	69,200	67,000
1	63,900	66,700	64,500
3	56,000	62,200	61,400
7	45,900	54,500	54,500
10	41,400	49,000	51,000
20	29,200	35,300	41,500
30	22,100	25,200	35,000
40	16,450	17,450	30,250
50	11,750	11,350	26,600
60	8,450	6,400	23,700
70	5,630	2,520	21,300

One can readily see that the new method used also by Dr. Wahl, gives better agreement with the actual stresses than the flat plate theory and, most important, it approaches the true stress within two per cent at the inner edge.

The measurements were carried out on a comparatively thick spring at a small deflection, but one should not conclude that in the case of a thin spring with large deflections a similar good agreement will exist. There will be more departure from the assumption that the cross section of the spring does not distort, merely rotates.

Concerning the permissible calculated stresses, the writer found that they may be as high as 220-240,000 pounds per square inch even under cyclic loading if the number of cycles is not too high and the deflection range is limited. This is particularly true of springs having nearly zero or negative rate characteristics. In such cases the stress vs. deflection curve is a second degree parabola and if one chooses judiciously the operating range near the top of the parabola, he may operate within a fairly wide deflection range with only small variations of stress. It should be emphasized, however, that in trying to get the maximum work out of a spring, only fatigue test can give an answer for each individual case.

Dr. Wahl has not mentioned the fact that in his paper dealing with radially tapered disk springs[3] he gives the derivation of the equations necessary to compute these springs when they are initially dished and the deflections are large compared to the thickness (Equations 28 and 30).

—A. LASZLO
Detroit

[1] *ASME Transactions*, 1936, RP58-10
[2] *VDI Forschung*, 1936, *Vol.* 7
[3] *ASME Transactions*, 1929, APM52-4

Requests Styling Reprint

To the Editor:

IF IT is available, we would appreciate receiving a reprint of the article appearing in the April issue of MACHINE DESIGN, page 23, entitled, "Illusions Aid Appearance," by Harold Van Doren.

—S. BROADWIN
Brooklyn, N. Y.

EDITOR'S NOTE: Clipsheets of Mr. Van Doren's article have been forwarded to Mr. Broadwin, reprints not yet being available. Other contributions on the subject of industrial styling by Mr. Van Doren will appear soon in MACHINE DESIGN, and following their publication it is expected they will be combined as a complete reprint of the series. In the meantime clipsheets will be sent promptly to interested readers as long as a supply is available.

Topics

DURING periods of economic depression the effect of machines on men and employment is discussed most widely and with the most heat. Relatively subdued when work is to be had, workers immediately blame the machine for layoffs. This fallacious attitude has been punctured so frequently and thoroughly that it scarcely merits further comment. Yet the hubbub lingers tenaciously. At the recent meeting of the American Society of Tool Engineers in Detroit a devastating counter blow was delivered in a statement from the National Industrial Conference board that in a total of 3,633,896 persons reporting unemployment in the 1930 census, only 10,651, or less than one-third of one per cent, stated "Machinery introduced" as the reason.

♦

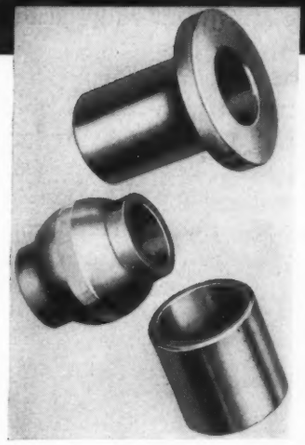
NEW fields for protective coatings are being conquered by spray guns using powdered materials. Metal alloys, specified by the user in any combination, have been used for some time. But even more significant, plastics, hard rubber, synthetic resins and other nonmetallic materials can now be shot through the gun, affording a wide sphere of coating possibilities. Proponents of the plan claim its potentialities have only thus far been touched.

♦

NEW YORK World's Fair this summer—and its companion one in San Francisco—are linked closely to designers of machines. At New York the "World of Tomorrow" will demonstrate the comforts and conveniences to be expected years hence. These advantages will be a direct result of continual, persistent improvement of machines of all kinds. . . . The "City of Tomorrow," with its living quarters in suburban locations providing excellent health and recreational facilities, will be achieved only because of greatly advanced transportation means. Healthier working conditions will come from better knowledge of industrial buildings and the mechanical equipment installed in them. Various increments of living—food, clothing, household accessories, luxuries—will be available more easily and cheaply because machines have improved manufacturing. One exhibit at the fair, the Community Interests Focal exhibit, will show graphically, by means of a number of display techniques, how living conditions have changed in the last 150 years because of technological advances. . . . Visitors who challenge the worth of machines will see at the Ford exposition a huge 160-ton press turning out inner shells for automobile hub caps at a cost of 12 and a fraction cents. Nearby will be a skilled workman producing the same parts at a cost of at least $2.50. Ford says a V-8 would cost $17,850 without modern machines. . . . Much of the equipment at the fair, like the sound-reproducing system at General Motors, has been made specially. Capable of delivering 150 different descriptive talks simultaneously, this complex machine is a corps of "private guides," which will act as escort to visitors at GM's exhibit. It is perfectly synchronized to 300 comfortable chairs on a continuous escalator. . . . Recognizing the relationship of the fair to the machine world, the 1939 World Automotive Engineering Congress of the Society of Automotive Engineers will be held in New York, May 22 to June 8. Sessions will report engineering advances throughout the world.

♦

LATEST developments in newspaper publishing not only may open new fields for makers of printing equipment but are indicative of the great changes which may come about in industry when a radically different method is introduced. Key to the change is the facsimile system of transmitting pages of news stories, wireless receiver for which was discussed in *M.D.*, February, page 32. One organization in New York is planning to establish newspapers in 25 main cities. A central office would transmit *by wire* virtually whole pages of condensed newspapers in magazine size, leaving only holes in the make-up for insertion of local stories. Printing would be done direct from the facsimile sheets, by the offset process. Proponents of the plan claim it will permit newspapers to be put on the streets much faster than is now the case. Another group of men in New York plans to start an entirely new paper in the metropolis, also in small size and printed by offset. Treatment of news would follow the news magazine style. Advances in facsimile transmission and in offset work will follow.



Every Designing Engineer should have a copy of the "COMPO" Bulletin

A *Symphony* in Bronze and Oil

The smooth-running machine or appliance can be likened to the harmonious synchronization of all elements in a symphony orchestra's rendition of a beautiful musical composition.

The symphony of porous bronze and oil, exemplified in "Compo" Oil-Retaining Bearings, provides coordination of every necessary and enduring element for smooth-working, uninterrupted performance—wherever there is a moving part, or wherever heat, wear, friction or lubrication-neglect bring discord to an otherwise perfect achievement.

BOUND BROOK OIL-LESS BEARING CO.
(Established 1883) MAIN OFFICE and PLANT: BOUND BROOK, NEW JERSEY
SALES and SERVICE: DETROIT, MICHIGAN AND LOS ANGELES, CAL.

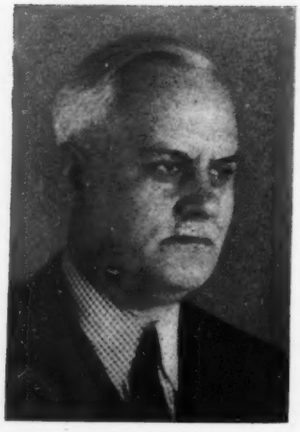
COMPO

OIL-RETAINING POROUS BRONZE BEARINGS

Men of Machines

E. C. KIEKHAEFER

CONSIDERABLE responsibility falls upon the shoulders of E. C. Kiekhaefer, recently appointed vice president of the Kiekhaefer Corp., Cedarburg, Wis., a newly-formed company. Upon completion of his schooling, at University of Wisconsin and Milwaukee School of Engineering, he joined the Seaman Body Corp. as engineering draftsman. Leaving this company he became connected with the Outboard Marine Corp., and later with the Stearns Magnetic Mfg. Co., in the capacity of designer. At the latter plant he had charge of the company's experimental laboratory and also did research work in conjunction with the Mellon institute. When this was completed he was given charge of factory production. Later he became chief engineer, his previous connection before becoming vice president of the Kiekhaefer Corp.



TOM ADDISON

NAMING of Tom Addison as chief designing engineer of Toledo Precision Devices Inc., brings to the fore a man eminently qualified for this work both by training and experience.

A native of England, Mr. Addison graduated from Sunderland Technical college and before coming to the United States in 1911 he obtained a number of years of practical experience. Since that time he has made his home in Cincinnati and has served in various capacities such as chief draftsman of Cincinnati Planer Co., chief design engineer for Cincinnati Grinders Inc., and at one time in charge of engineering, Karl Keifer Machine Co., manufacturers of automatic liquid filling machines. This experience has given him a thorough and detailed knowledge of the machinery field, making him a valuable addition to his new organization.

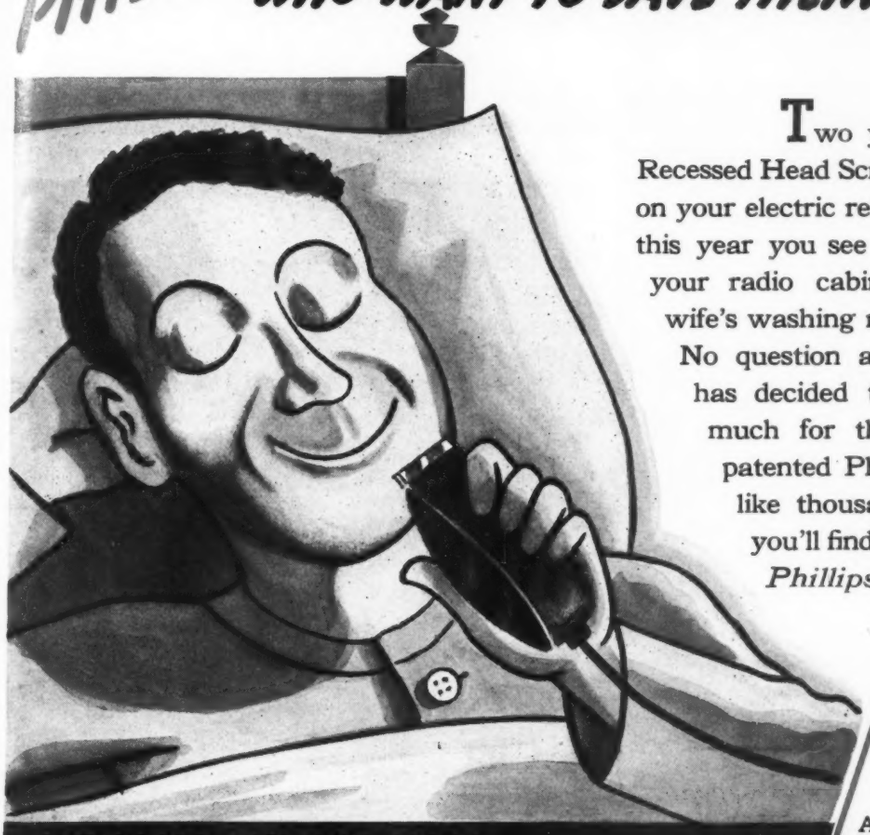
JAMES R. WEAVER

JAMES RILEY WEAVER, Westinghouse Electric & Mfg. Co., has been elected president of American Society of Tool Engineers. His background in machine design goes back to his experience in the period prior to the World war when he designed special machines and machine parts for the manufacture of shells.

Born near Pittsburgh, he has been associated with the Westinghouse company since the age of 16. Upon completing his apprenticeship course he remained with Westinghouse Air Brake Co. as master mechanic until 1916 at which time he joined the Westinghouse Machine Co. When this company moved he was transferred to the Westinghouse Electric & Mfg. Co. as works mechanical engineer and supervised the design of special machines in that capacity for eleven years. Types of machinery for which he

PHILLIPS SCREWS FOR MEN

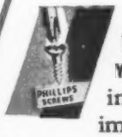
WHO WANT TO SAVE THEMSELVES TROUBLE



Two years ago, you found Phillips Recessed Head Screws in your new car, last year on your electric refrigerator, your furniture. And this year you see them on your electric razor, your radio cabinet, your lawnmower, your wife's washing machine.

No question about it — industry at large has decided that slotted screws cost too much for the troubles they cause. Put patented Phillips Screws in your plant — like thousands of other manufacturers, you'll find out that *it costs less to use Phillips Screws.*

CUT COSTS 50% AND MORE BY ENDING ASSEMBLY TROUBLES



This valuable booklet shows how **YOU CAN MAKE SAVINGS** in assembly cost immediately. Address one of the firms below for free copy.

NO TIME WASTED. The Phillips Recessed Head Screw clings to tapered Phillips driver. No screws fumbled. One-hand driving.

NO SPOILAGE. The driver can't slip from the Phillips recess. Faster driving methods (including power drivers) are safe to use.

REJECTS ELIMINATED. Greatly increased holding power — no loosening in service.

PHILLIPS RECESSED HEAD CAN'T SPLIT. Taper and depth of Phillips recess carefully worked out to utilize driver's *maximum* turning power — without sacrifice of strength in screw head. Flat surfaces — no sharp corners; so no burring. 4 sizes of Phillips Drivers provide greatest efficiency for all Phillips Screw sizes. 2 sizes fit diameters #5 to #16 inclusive.

PHILLIPS *recessed head screws*

MACHINE SCREWS · SHEET METAL SCREWS · WOOD SCREWS · STOVE BOLTS

U. S. Pat. on Product and Methods Nos. 2,046,343; 2,046,837; 2,046,839; 2,046,840; 2,082,085; 2,084,078; 2,084,079; 2,090,338

American Screw Co., Licensor
Providence, R. I.
Chandler Products Company,
Euclid, Ohio
Continental Screw Company
New Bedford, Mass.
Corbin Screw Corporation
New Britain, Conn.
The Lamson & Sessions Company
Cleveland, Ohio
National Screw & Mfg. Co.
Cleveland, Ohio
Parker-Kalon Corp., New York, N. Y.
Pheoll Manufacturing Co., Chicago, Ill.
Russell, Burdsall & Ward Bolt & Nut Co.
Port Chester, N. Y.
Scovill Manufacturing Co.
Waterbury, Conn.

IT COSTS LESS TO USE PHILLIPS SCREWS

was responsible include presses, coil wrapping, testing machines and many others.

Besides designing special machines, he has also been active for the company in machine tool specification. He was appointed to his present position as director of equipment, inspection, purchases and tests in 1928.

♦

HOWARD SIMPSON has become affiliated with Detroit Harvester Co. to supervise engineering and development work on a new line of agricultural implements, including power takeoff devices. Mr. Simpson has for many years been active in engineering development work at Ford Motor Co.

♦

L. R. KELLS has been named chief engineer of Salem Engineering Co., Salem, O. He has been associated with the industrial furnace industry for over 20 years.

♦

ALBERT E. HACKET who was formerly connected with Thomson-Gibb Co., has joined Progressive Welder Co. in an executive capacity. Mr. Hacket has had extended experience with resistance and other types of welding design.

♦

J. F. MCINTIRE, vice president of the United States Radiator Corp., has been elected president of American Society of Heating and Ventilating Engineers.

♦

PROF. FRANK B. ROWLEY, director of engineering experiment station, University of Minnesota, has been awarded the American Society of Heating and Ventilating Engineers' medal "for distinguished scientific achievement in heating and air conditioning."

♦

JOHN J. CROWE, research engineer, Air Reduction Sales Co., has been awarded the James Turner Morehead medal for his successful technical activities in the utilization of acetylene.

♦

ROY C. MUIR is one of four graduates of University of Wisconsin selected by the board of regents to receive honorary degrees. Mr. Muir, who is vice president in charge of engineering, General Electric Co., will receive the honorary degree of doctor of engineering.

♦

WILLIAM ABBOTT LEWIS JR. has been appointed director of the school of electrical engineering, college of engineering, Cornell university. Mr. Lewis was an engineer with Westinghouse Electric & Mfg. Co.

♦

HUBERT D. TANNER, manager of the machinery department of Pratt & Whitney division, Niles-Bement-Pond Co., Hartford, Conn., has been elected vice president. Mr. Tanner has been engaged in engineering development and has been responsible for advances in the company's line of gear grinding machines. He has also done considerable work in connection with automobile transmission gearing. In addition to being vice president he will continue in his present capacity as manager of the machinery department.

♦

VICTOR BROOK has resigned as chief engineer of High Speed Hammer Co., Rochester, N. Y., manufacturer of riveting machinery and precision drilling machines.

♦

HAROLD S. FALK, vice president and general manager, Falk Corp., Milwaukee, will receive the John A. Penton gold medal at the forthcoming annual convention of the American Foundrymen's association in recognition of his leadership in promoting interest in foundry apprentice training. DONALD J. CAMPBELL, president, Campbell, Wyant & Cannon Foundry Co., will be awarded the W. H. McFadden gold medal for outstanding accomplishments of this company in casting manufacturing process; while the J. H. Whiting gold medal will be presented to JAMES R. ALLAN, assistant manager of industrial engineering and construction, International Harvester Co., for his engineering contributions.

♦

DAVID DASSO has resigned as president of American Locomotive Co. diesel engine division, New York. He will, however, continue with the company in a consulting capacity.

♦

FRANK W. CURTIS has been made chief engineer of the Van Norman Machine Tool Co., Springfield, Mass. Mr. Curtis was for many years research engineer for the Kearney & Trecker Corp., Milwaukee.

♦

M. W. LAMPRECHT has been named chief engineer of Acme Machinery Co., Cleveland.

♦

JESSE MARSTEN has recently been appointed vice president of International Resistance Co., Philadelphia. He will continue in his capacity as chief engineer.

♦

NATHAN SCHNOLL, formerly chief engineer of Solar Mfg. Corp., has become president and chief engineer of Industrial Instruments Inc., Bayonne, N. J., a newly-formed company.

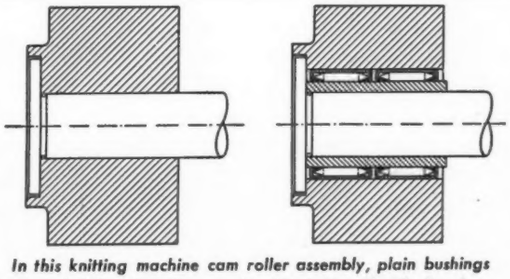
♦

JAMES E. BEVAN has recently been made assistant chief engineer of The Roller-Smith Co. Previously he has been switchgear specialist for the company.

CONSIDER THESE LUBRICATION ADVANTAGES of the TORRINGTON Needle Bearing

THOROUGH, efficient lubrication with little service attention is an important advantage inherent in the design of the Torrington Needle Bearing. The turned-in lips of its hardened retaining shell form a reservoir that holds plenty of grease or oil for long periods of operation. Rotation of the rollers constantly supplies lubricant to the rotating shaft.

Consider the advantages of these features in a typical application, taken directly from the files of our Engineering Department. In the knitting machine cam roller assembly illustrated, the plain bushings formerly used required *daily* lubrication. The Torrington Needle Bearings now used *in the same service* need lubrication only *twice a year*. Note, too, how easily the product design was adapted to incorporate the Needle Bearings in place of the bushings.



In this knitting machine cam roller assembly, plain bushings needed daily lubrication service. Torrington Needle Bearings are lubricated only twice a year in the same service.

Adaptable to Varied Lubrication Requirements

The Needle Bearing is equally well suited for applications requiring special lubrication because of speed and load conditions. The bearing can be supplied with an oil hole, which makes it readily adaptable to gravity feed or pressure lubrication systems. Moreover, the lips of the Needle Bearing fit closely to the shaft, aiding in the exclusion of dirt and other foreign matter. The Needle Bearing is ideally suited to high-speed operation at heavy radial loads, as its many linear inches of contact give high load capacity.

You can obtain these advantages in your own product at surprisingly little expense, because the Needle Bearing is low in unit cost and easy to assemble. The Torrington Engineering Department will cooperate with you in laying out applications utilizing the advantages of this unusual bearing.

For further information, write for Catalog No. 9. For Needle Bearings to be used in heavier service, request Booklet No. 103X from our associate, Bantam Bearings Corporation, South Bend, Ind.

The Torrington Company
ESTABLISHED 1866
Torrington, Conn., U.S.A.
Makers of Ball and Needle Bearings
Branch Offices in all Principal Cities

TORRINGTON NEEDLE BEARING

ASSETS *to a* BOOKCASE

The Theory of Machines

By Thomas Bevan; published by Longmans, Green & Co., New York; available through MACHINE DESIGN *for* $5.40 *postpaid.*

The author, Thomas Bevan, lecturer in mechanical engineering at the university and college of technology, Manchester, England discusses this comprehensive subject in a recently published 550-page book. Elementary mechanics are largely reduced because of the scope of the book, though certain fundamental principles are emphasized and extended.

Both graphical and analytical methods are used for determining velocities and acceleration of parts. Toothed gearing and gear trains are discussed for many forms and applications. Extended treatment of belt and rope drives supplements previous discussions. Balancing of both revolving and reciprocating masses is considered with respect to their ever-increasing importance at present-day high speeds. Calculations for partial, primary and secondary balancing are developed and the principles applied to locomotives, in-line engines and cranks. Forms of static and dynamic balancing machines and their functions are also discussed. Natural, damped and forced vibrations and their calculations and control are treated in various combinations. Critical speeds and torsional vibrations are included.

□ □ □

Heat Treatment of Metallurgical Products

By Albert Portevin; published by Penton Publishing Co.; available through MACHINE DESIGN *for* $5 *postpaid.*

Research engineers, metallurgical students and steel plant metallurgists as well as others engaged in metallurgical investigation and the heat treatment of ferrous and nonferrous metals will find this work valuable. The author, Albert Portevin, distinguished French physical metallurgist, has treated the subject from the standpoint of experimental determinations and facts resulting from observation.

Fundamental and essential principles of thermal treatments of steels are discussed in a simple manner. Subjects include transformation points of steel, preliminary treatment of steel, quenching, hardened steels, hardening capacity of steel, tempering, classification of industrial steels, annealing, malleabilization of cast irons, heat treatment of light aluminum alloys, etc.

Ideas and directions to interpret and understand the phenomena and solve the difficulties which actually occur in heat treatment are included rather than recipes, formulas or numerical results.

Machinery's New Handbook

Published by the Industrial Press, New York; available through MACHINE DESIGN *for* $6 *postpaid.*

This tenth edition contains 1815 pages, 250 of which were not included in the previous edition. New and revised material consists mainly of engineering and manufacturing standards, machine shop data and general information required by designers.

New features include standard mounting dimensions with horsepower and speed ratings for different types of motors; the British standard limits and fits for holes and shafts; the American standard for different gages; additional data on screw thread standards; tables for checking gear sizes by the pin and chordal methods of measurement; standard tolerances for forging; American standards for drawings and standard abbreviations and symbols; selection of lubricants for bearings; standard V-belt drives; steels for gearing; brass, bronze and nonmetallic gearing; recent setscrew standards; new hardness conversion tables; checking screw thread sizes.

The book is divided into 134 main divisions featuring subjects of importance to those responsible for the design or construction of mechanical equipment. Character of the book is similar to that of preceding editions and includes mathematical tables.

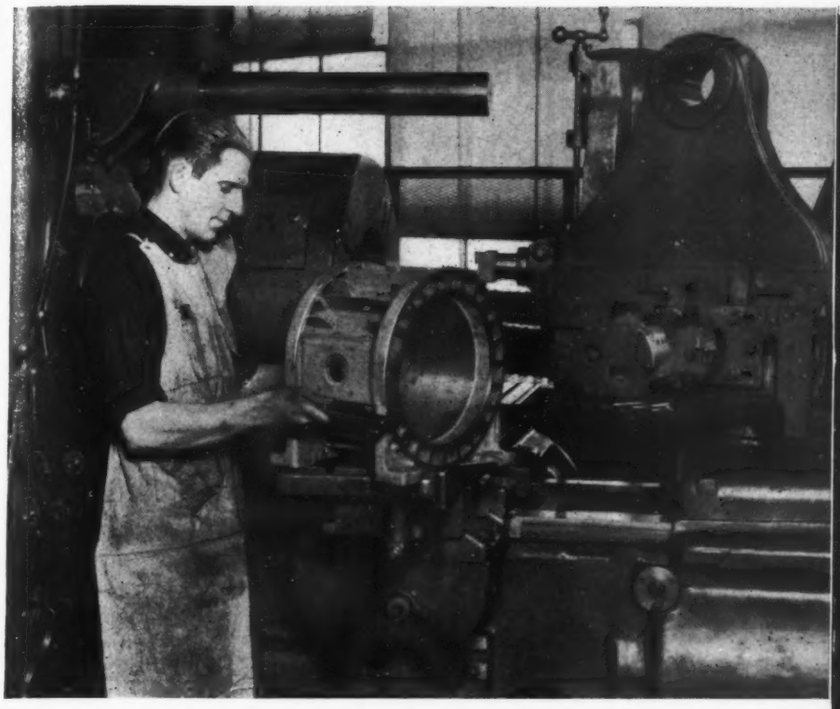
□ □ □

Strength of Materials

By Norman C. Riggs and Max Frocht; published by the Ronald Press Co., New York; available through MACHINE DESIGN *for* $3.75 *postpaid.*

Essentials of strength of materials and calculations of stresses are covered in this 432-page volume. Of particular interest is the discussion of photoelasticity and its application to stress studies. Stress patterns and rules for interpreting them are treated together with curves for photoelastic and theoretical results. Also worthy of note are the elimination of the cumbersome method of computing deflections by double integration and the introduction of the Hardy Cross method of moment distribution and its application to continuous beams.

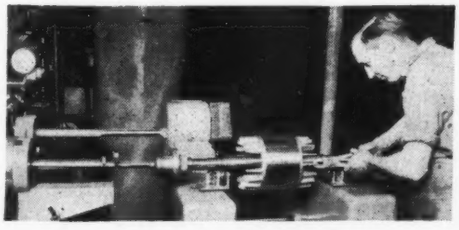
Stress concentrations as a dominant cause of fatigue failure are discussed, as are curves and factors which have found frequent application in industrial design. Patterns illustrated include rivet in plate, beams subjected to bending, loaded columns, eccentrically loaded split ring, centrally loaded arch, bars in tension and compression, stresses around holes, bars with grooves in tension, and beams with fillets and grooves subjected to bending.



TURN TO THE INDEX

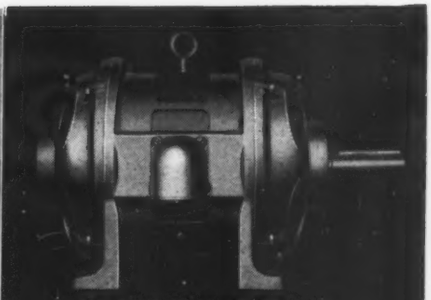
for a story of better alignment

The manufacturing methods employed by Delco to maintain the perfect alignment of Delco motors throughout production are interesting—and they are important to the user's final satisfaction. Typical of these methods is the operation pictured here. After the motor frame feet have been milled and drilled in one set-up, establishing the initial alignment, the holes are indexed in this large turret lathe chuck by four dowel pins. With the casting thus correctly aligned, the stator bore, both ends of the frame and surfaces for the location of end frames are machined in a single group operation. Very close limits on shaft height and alignment are definitely insured, and all alignments must check in succeeding operations. Because the workmanship of Delco motors is exceptional, we ask you to look within the motor you specify. Write for catalog.

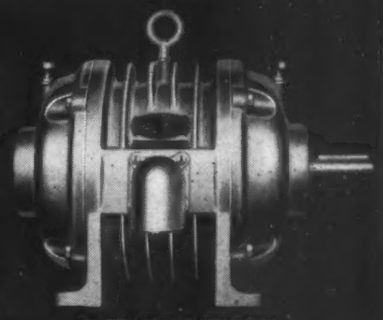


EVERY DELCO MOTOR IS DYNAMICALLY BALANCED

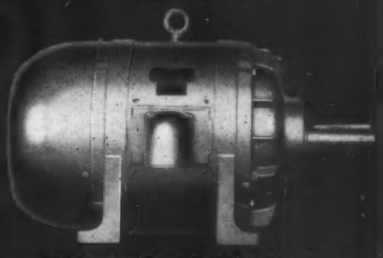
No motor leaves Delco Products that has not been dynamically balanced on a specially-designed balancing machine. Delco balances every motor. Each end of the rotor and shaft is first balanced independently while the machine indicates exactly how much compensation is required and where it should be applied. After all adjustments have been made, the complete rotating assembly is given a final check. Delco motors assure satisfactory balance.



Open Frame, Sleeve or Ball Bearing



Totally Enclosed Ball Bearing



Totally Enclosed Fan-Cooled Ball Bearing

Fractional Horsepower Motor

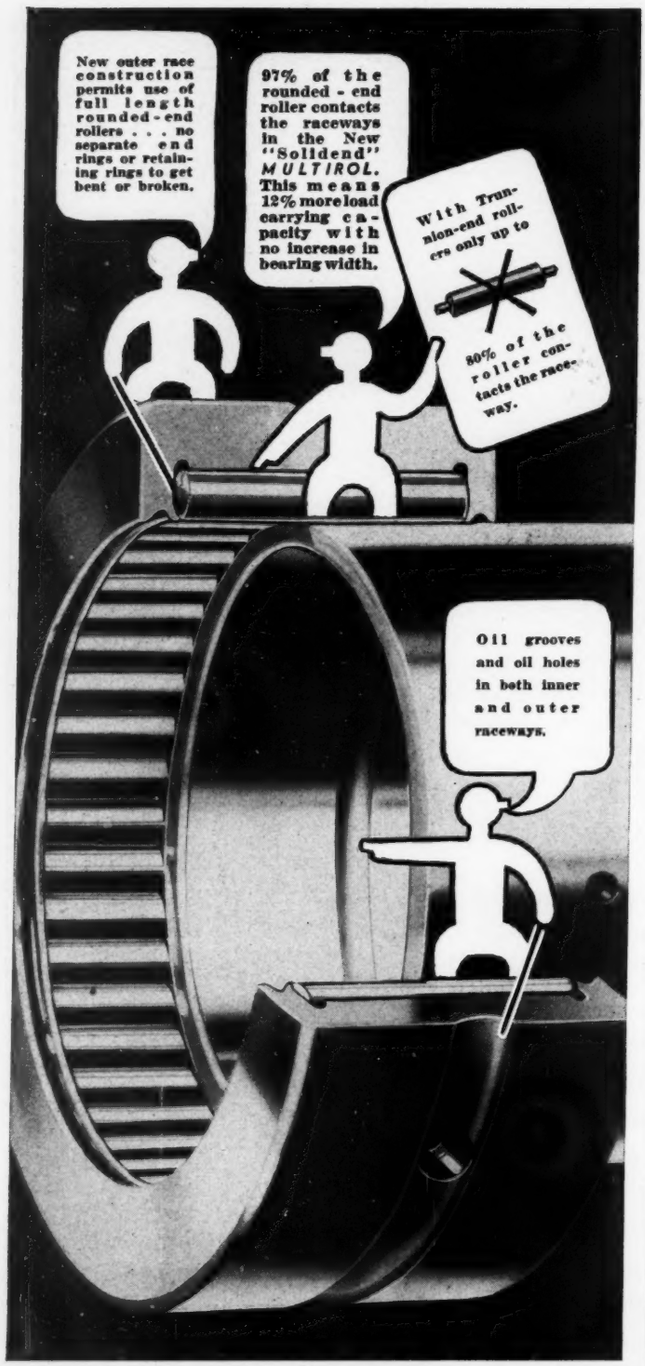
• • •

Delco industrial AC motors are available in various types, possessing electrical and mechanical characteristics to meet practically every requirement.

Normal starting torque—normal starting current—high starting torque—low starting current—as well as high slip. Each type available in open frame, sleeve or ball bearing—totally enclosed ball bearing—totally enclosed fan-cooled ball bearing—also multi-speed motors. Electrical and mechanical modifications available. Delco motors comply with NEMA standards.

DELCO MOTORS

DIVISION OF GENERAL DELCO PRODUCTS DAYTON, OHIO MOTORS CORPORATION


New outer race construction permits use of full length rounded-end rollers . . . no separate end rings or retaining rings to get bent or broken.
97% of the rounded-end roller contacts the raceways in the New "Solidend" MULTIROL. This means 12% more load carrying capacity with no increase in bearing width.
With Trunnion-end rollers only up to
80% of the roller contacts the raceway.
Oil grooves and oil holes in both inner and outer raceways.

McGILL'S New "Solidend" Multirol

With an entirely new type of race construction, the New "Solidend" *MULTIROL* utilizes full length rounded-end rollers, increasing by 12% the load carrying capacity in comparison with bearings of the same width. Without end washers or retainer rings, the New "Solidend" *MULTIROL* is simple in construction, low in cost, and easy to install. Can be used either with or without inner raceway and is available in shaft sizes up to 6 inches. A minimum of clearance between end shoulders and inner raceway makes bearing self-sealing. Simplified construction means lower cost to you, and a bearing that is easier to install. Write for further details.

McGILL MANUFACTURING CO.

1450 N. Lafayette Street VALPARAISO, INDIANA

Noteworthy Patents

Valve Throttles Hydraulic Coupling

CONTROL of fluid volume for throttling hydraulic couplings is effected by a ball valve which is responsive to fluid pressure differential rather than tension resistance of a diaphragm or pressure of a spring. The design illustrated in *Fig.* 1 is covered by patent 2,141,305 issued to Ludwig Koesters, Berlin, and assigned to General Electric Co.

Simplicity of construction, independence of springs or diaphragms and sensitive throttling are features of the design. The valve ball shown at top right is

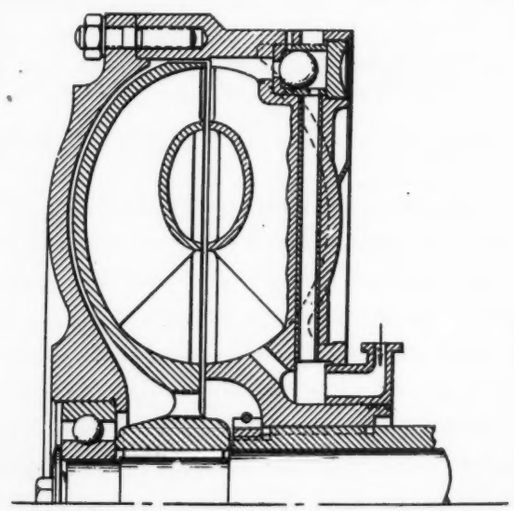


Fig. 1—*Fluid pressure differential controls ball valve in hydraulic coupling. Complete throttling is effected by shutting off supply fluid*

free to move from left to right in its chamber depending on fluid pressure. In operation fluid under pressure is admitted at inlet near hub. A by-pass admits pressure to valve, closing it. Valve movement is due solely to unbalance between pressure of fluid in casing and fluid supply. When the casing fluid pressure overcomes that of the supply, the ball moves to the right and permits fluid to escape to the outside of the casing through an escape channel. Size of escape channel is determined by time required to empty casing for complete throttling.

Power is transmitted to turbine wheel when operating fluid is admitted. As a result of the relative motion between the turbine and pump vanes, the fluid is given a helical motion and with the addition of centrifugal force a pressure is built up which tends to

.... *Two New*
Centrifugal Motorpumps

Compact — Modern — Flexible in Installation —

for Supplying Coolant

or for light transfer work

Can be mounted either horizontally or vertically.

Motors are fully enclosed with permanently sealed ball bearings for dependability and long service.

— No. 240 has flange mounting integral with pump - - - - eliminating inlet piping.

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— Geared — Vane — Centrifugal — including Motorpumps —

for — Circulating Liquids
— Forced Feed Lubrication
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— Hydraulic Systems

Write for Pump Catalog.

Brown & Sharpe Mfg. Co.
Providence, R. I., U. S. A.

BROWN & SHARPE

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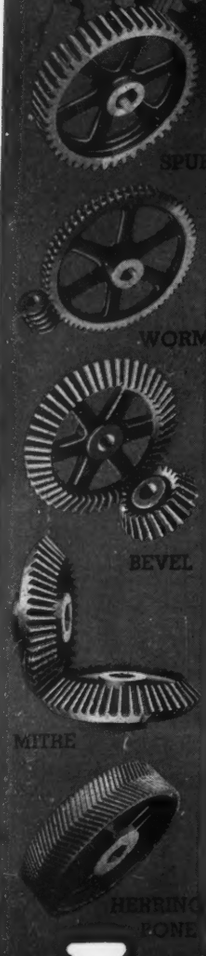

JONES gear cutting practice represents the accumulated technical knowledge of 46 years backed by the finest gear cutting equipment and craftsmanship to be found anywhere in the world.

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FRICTION CLUTCHES AND TRANSMISSION APPLIANCES

release the valve being held closed by the by-pass pressure. Thus a continuous throttling action is present. When the supply fluid is shut off, the pressure in the valve chamber holding the valve closed is reduced by fluid leakage past the ball through the clearance space which necessarily must be provided to permit the ball to move freely.

Air Controls Motor Speed

SPEED control of motors for household machinery is effected pneumatically in the design illustrated in *Fig.* 2. A contacting device is positioned in air stream generated by an impeller on armature shaft in such a way as to make and break current supply in response to air volume. Thus motor speed is held constant at each speed setting desired.

When knob at extreme left is turned slightly, contact points are closed and motor turns at its lowest speed. Air is moved by impeller past opening below a control vane. The vane impedes the air passage and moves outwardly. Should the flow exert a predetermined force, the vane contacts (not shown) open causing the current to flow through a resistor. When the speed of the motor decreases to a point at which the force is insufficient to hold the vane open the contacts close again and current flows direct to motor.

Rotation of the knob adjusts the contact points so that more force is required to open them. In other words, the vane will have to be moved a greater distance against the increase in tension to open the contacts requiring more air pressure from the impeller and, in turn, higher motor speed.

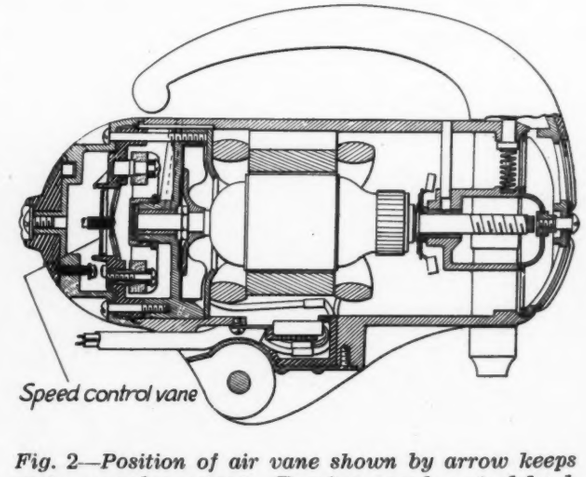
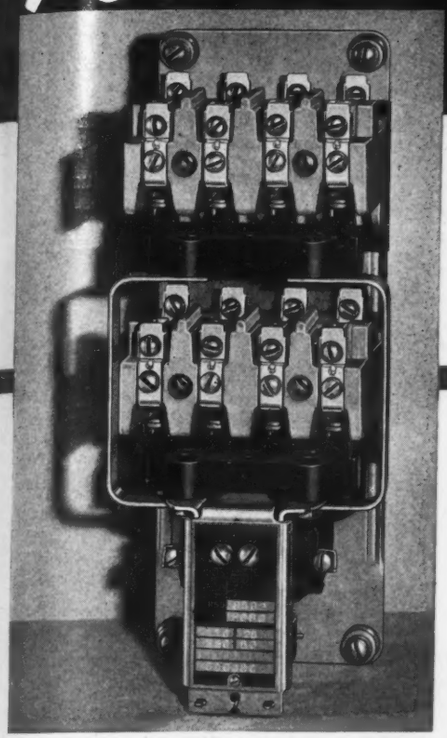


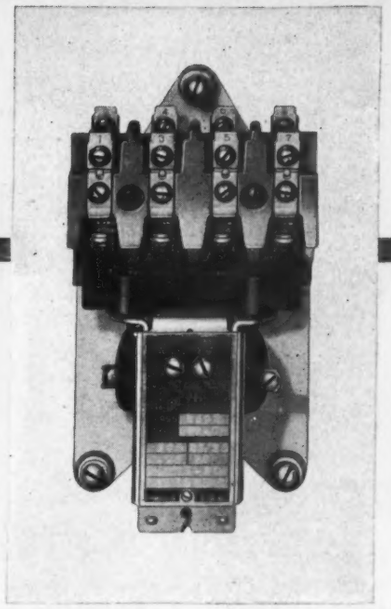
Fig. 2—Position of air vane shown by arrow keeps motor speed constant. Turning speed control knob increases switch contact opening pressure

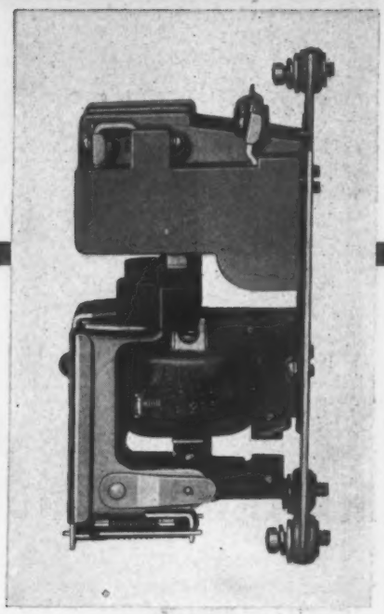
Approximately the same air opening throughout the length of the vane stroke is provided by ribs. The opening is larger than the vane to allow free movement and also, the air to pass through the opening. Air stream passes over the motor to cool it as well

New! SQUARE D MULTI-POLE CONTACTORS

SIZE 0 . . CLASS 8502 . . TYPE R







WITH FEATURES THAT MACHINE DESIGNERS WILL APPRECIATE

Any combination of normally open or normally closed contacts—two poles to eight poles inclusive.

Any pole can be changed from normally open to normally closed or vice versa without the addition of any parts and with no tools except a screwdriver. The two sketches at the right show how this is accomplished. When parts numbered 1, 2, 3 and 4 in upper sketch are removed and re-assembled as shown in lower sketch, the contact is changed from normally open to normally closed.

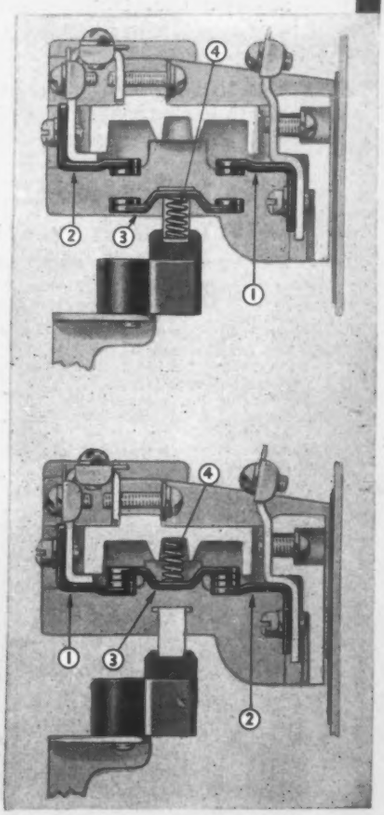
Contactor is assembled on a steel base and is supplied with specially designed rubber grommets and screws for mounting purposes. The screws do not come in direct contact with the base but pass through sleeves supported by the grommets. Therefore, the contactor base may be securely fastened to a rough surface without compressing the grommets or distorting the base.

Contactors operate vertically, preventing accidental closing caused by vibration or shock.

Contacts are silver to silver, double break—will satisfactorily rupture the stalled rotor current of any motor for which the contactor is rated.

Power connections are made in U-shaped wiring clips—eliminating the necessity of looping wires.

These contactors can be used as motor starters, for sequence interlocking or as relaying devices for the control of solenoids in hydraulic or mechanical operations.



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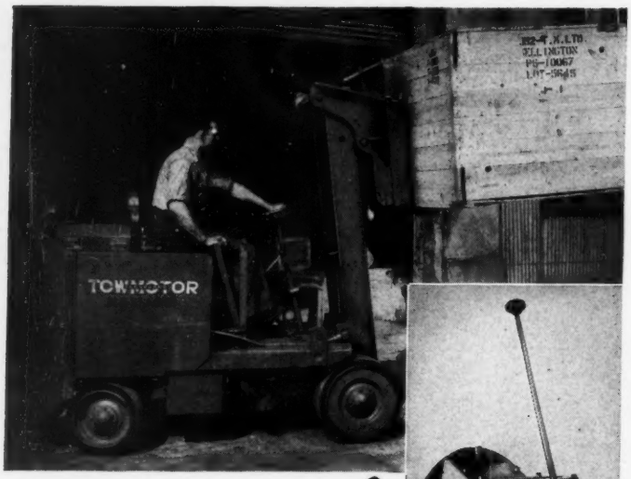

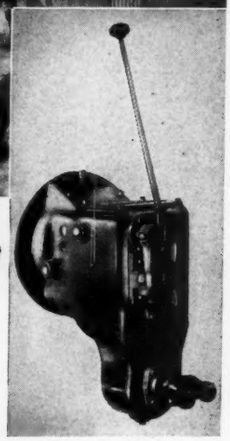

Geared-
TO THE TOUGH
MATERIAL HANDLING JOBS

For 20 years Towmotors have been recognized for their low-cost, trouble-free service. One reason is—*gears.* The transmission, for instance. Here, the gears must "stand the gaff." Day in, day out, these busy trucks are hauling loads 15 or more times their own weight. So Towmotor engineers insure the dependability of their transmissions. They use Ohio Gears.

You too will find profit in Ohio Gears for your requirements. And Ohio Gear engineers will be glad to cooperate on your transmission problems. Write for our new 1939 Catalog and get in touch with the nearest representative.

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1338 E. 179th Street • Cleveland, Ohio

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OHIO GEARS

as the resistor. Clearance at the vane insures an air stream at all times and prevents overheating. This motor and control was designed by Ivar Jepson and is covered by patent 2,144,734 assigned to Chicago Flexible Shaft Co.

Pressure Pump Utilizes Helical Screw

HELICAL screw pumps using liquid as a pressure medium have recently been patented for use as gas compressors. A simple rotary structure as illustrated in *Fig.* 3 enables the pump to build up higher pressures than possible with centrifugal pumps and

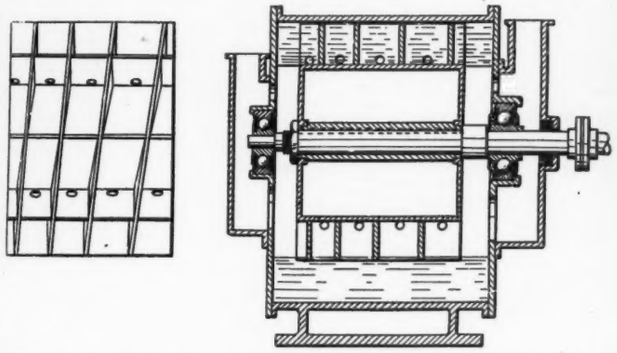


Fig. 3—Rotary pump creates increased pressure through use of helical screw and liquid sealing medium

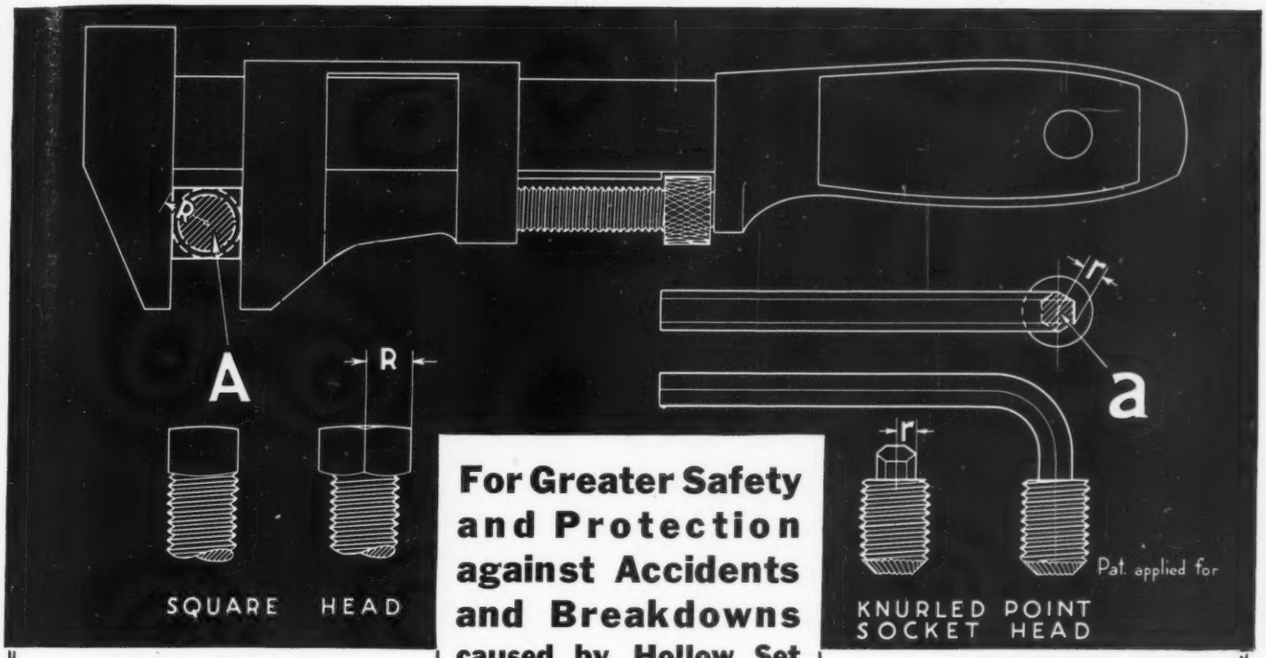
yet be free from reciprocating parts such as pistons or vanes.

Designed by Kemper P. Brace and covered by patent 2,145,644 assigned to the International Engineering Co., the pump is arranged so that the axis of the rotor is above that of the housing; thus, in operation, the centrifugal force of the liquid encloses the vanes at the top and seals the edge of the vanes at the bottom. In this way the gas being compressed travels progressively toward the outlet at the left. The helical screw shown has decreasing spacing toward the compression side to provide the equivalent of a multistage compressor.

Sufficient water or liquid which will not react with the gas being pumped is contained in the housing to fill the area shown when equally distributed around the casing by centrifugal force caused by the vanes. Vacuum created by the rotating screw allows gas to enter the intake at the left. As it is fed progressively to the right along the bottom of the rotor by the decreasing volume of the screw spacing it is compressed and pumped through the outlet at the right.

Since the liquid seals the edges of the screw at the bottom of the casing and entirely fills the spaces between at the top, there is only one path for the gas as it compresses. That is through the outlet. In this way it is possible to pump at pressures limited only by the ability of the liquid to withhold them. Vapors of the liquid present should also be taken into consideration in applications of this type of compressor.

Here's the Proof



For Greater Safety and Protection against Accidents and Breakdowns caused by Hollow Set Screws Working Loose

YOU NEED

UNBRAKO

SELF-LOCKING

Hollow Set Screws

WITH THE KNURLED POINTS

Fig. 1645
Pat. App. for

Fig. 1641
Pat. App. for

There was a time when it was perfectly all right for Square-Head Set Screws to project from all kinds of exposed hubs and whirling machinery, in spite of the obvious danger involved.

But that was before the "Safety First" movement got under way and finally swept the country.

Before long the dangerously projecting Set Screw was "taboo" throughout industry, to be replaced by the Safety Socket Set Screw—used almost exclusively today.

While invariably a fairly hefty monkey-wrench is being used for pulling up and backing off Square-Head Set Screws; the Safety Set, on the other hand, and due to its Socket feature, can only be worked by a comparatively light and short hex bar-wrench, and therefore cannot be tightened up anything like as hard as its Square-Headed rival.

The result of this is that Socket Set Screws, especially when subjected to more than ordinary vibration, are quite liable to shake and work loose; the advent of the Knurled Point "Unbrako" Socket Set Screw completely overcomes this drawback. By knurling the point the "Unbrako" takes such a hold—gets such a tenacious grip—that it just can't and therefore won't shake loose, even when pulled up only moderately hard, and thereby becomes an ideal self-locker.

The screws shown on blue print above, while of the same diameter, are, however, of two different types—the one on the left a Square-Head Set between the jaws of a monkey-wrench; the one on the right a Socket Set with hex bar-wrench inserted.

Reference is made to the cross hatched area at the root of thread of the Square-Head Screw by the letter "A" and similarly to the section of the hex bar-wrench by "a" and hatchings—these being the two critical sections.

The ratio between areas "A" and "a" is about 3 to 1, and inasmuch as the steels of which both screws and the hex bar-wrench are made differ very little in strength, it is obvious that the latter would twist off at a torque that would not affect the Square-Head Screw to any appreciable extent—in other words, the Socket Set can't possibly be pulled up as hard as the other, which merely goes to prove how necessary the Knurled Point is, as contended above.

STANDARD PRESSED STEEL CO.

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275 years of experience have gone to the making of Mars LUMOGRAPH. The result is that thousands of architects, engineers, draftsmen say that LUMOGRAPH actually does improve their work. Try it—prove it—use it yourself. Now obtainable in 19 degrees—15c each—$1.50 the dozen packed in a metal box. If your dealer cannot supply you, send us your order and his name.

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strong — brilliant
made in 16 special colors.

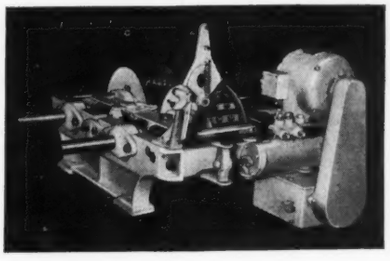
MARS LUMOGRAPH

J. S. STAEDTLER, INC.
53-55 Worth St. **New York**

NEW Materials and Parts

Hydraulic Control for Variable Speed

REEVES Pulley Co., Columbus, Ind., announces an improved type of hydraulic automatic control for use with the Reeves variable speed transmission. This control provides entirely automatic speed regulation to make possible synchronization of different machines and separate sections of a single machine; maintenance of constant tension and uniform peripheral winding speeds; maintenance of uniform pressure, weight, liquid level, temperature and other variable elements. The control is simple and compact in design, with few working



Entirely automatic speed regulation to synchronize different machines is provided by improved hydraulic control

parts. Pressure of only two or three ounces will produce change in speed. From 6 to 20 seconds are required to shift the transmission from maximum to minimum speed and vice versa, depending on size and ratio. A protective mechanism absorbs the shock of sudden or violent shifting. As shown in the illustration the control is mounted at one end of the transmission frame, with a self-contained hydraulic power plant on the right-hand set of shifting levers of the transmission. The control lever can be located anywhere on a 360-degree circle to give direct connection to the operating mechanism.

Motor Units Include Spindle Head

DESIGNED for industrial uses where a compact motor and spindle head in one unit assembly is utilized as a direct power head drive, a new line of precision-built geared head motors has been placed on the market by the Portman Machine Co., 2236-A Bathgate avenue, New York. The built-in spindle unit of these motors features an offset shaft of the parallel type in a gear housing of compact design. Mounted on duplex type preloaded bearings for maximum rigidity, the spindle is driven through helical gears of wide

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Cuno *continuously cleanable* filters are used by the United States Navy, where they are making the astonishing record of removing 99% of an immiscible liquid whose dangerous content may run as high as 3% of the total liquid volume. Naturally, we are not at liberty to reveal details of this work — but —

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Every day in every industry where fluids are strained, including air and gases, Cuno *continuously cleanable* filters are making money. They are simply a series of metal discs stacked on top of each other, but accurately spaced as close as .0025". The fluid, which might be glue, oil, or anything else, flows edgewise to the discs. Can you picture it? And blades between the discs, *clean* them out in one quick revolution.

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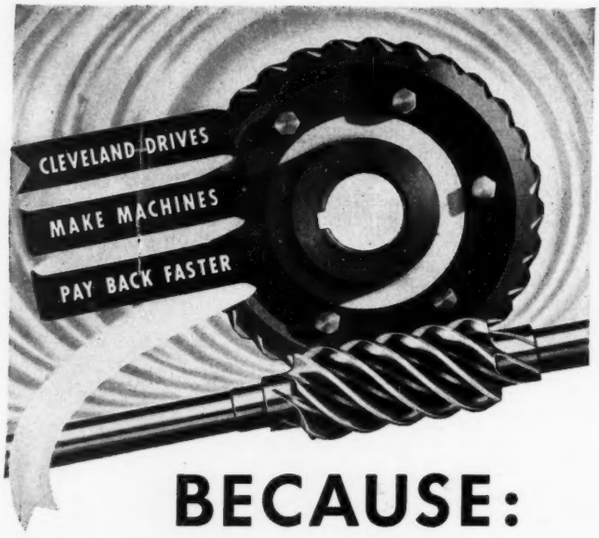
CUNO ENGINEERING CORPORATION ★ MERIDEN, CONNECTICUT



BECAUSE:

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One of the largest organizations of Steel Plant Engineers uses Cleveland Worm Gears to drive stock distributors on blast furnace tops. The intermittent impact from frequent starting and stopping throws severe shock loads on these Drives.

Even under such severe conditions, Clevelands give continuous and satisfactory service. For years this Company has used Clevelands as standard and has installed them all over the world.

This dramatic performance is duplicated daily in hundreds of other Cleveland installations in steel and in every other major industry. *You* can secure the same dependability and increased earning power from your equipment without paying a premium—because, on the basis of delivered horsepower and comparable design, your customers pay no more for the outstanding service that Clevelands provide.

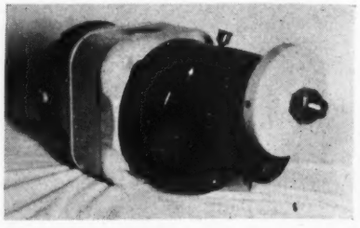
Design Engineers who do not already have the 150-page book "Cleveland Worm Gear Speed Reducers" are cordially invited to write for a copy at once. Invaluable information, interesting pictures and exhaustive tabular data make it a book to be kept and used daily.

The Cleveland Worm & Gear Company, 3275 East 80th Street, Cleveland, Ohio.

Affiliate: The Farval Corporation, Cleveland, Manufacturers of Centralized Systems of Lubrication

CLEVELAND WORM GEAR Speed Reducers

face. The spindle and gear housing incorporates integrally built-in seals completely protecting the entire assembly against foreign matter. These motors are available in sizes from one to five horsepower for various current requirements, with standard spindle



Geared head motors are intended for industrial uses where a compact motor and spindle head is utilized in unit assembly

speeds of 1150, 1725, 2300, 3450 and 5600 revolutions per minute. Spindle nose ends of various types are available, including standard shaft and keyway, threaded shaft ends with nuts and standard or special collars, taper and chuck type.

Announce Rocker Type Safety Switch

THE rocker type safety switch announced by Bull Dog Electric Products Co., 7610 Joseph Campau avenue, Detroit, has a curved molded handle which is rocked by thumb action to "On" or "Off" position. Handle and switch mechanism are

Handle and switch mechanism of rocker type safety switch are all one piece, operating on frictionless knife-edge bearings

all one piece, operating on frictionless knife-edge bearings. Of modern "streamlined" design, the switch is a 30-ampere, front-operated enclosed unit. Other features are positive action full-floating contacts, screw type wiring terminals, ten well-placed knockouts, silver-surfaced current carrying parts.

Enamel Speeds Industrial Finishing

LOW-BAKE "Dulux" enamel for industrial finishing has been announced by E. I. du Pont de Nemours & Co., Wilmington, Del. Speeding up production in low-temperature ovens it affords the following baking schedules: One-quarter hour at 250 degrees Fahr.; one-half hour at 225 degrees Fahr.;

You wouldn't set up screws this way

BUT *THESE* SOCKET SCREWS* HAVE THE TORQUE STRENGTH TO STAND SUCH LOADS!

TORQUE TESTS - - in Parker-Kalon's Laboratory - - make certain that Parker-Kalon Cold-forged Socket Screws can be set up TIGHTER without twisting off the heads. *For instance, a 1/2"-20 (N.F.) Cap Screw must take a 2200 inch pound minimum load.

"16 POINT QUALITY-CONTROL" Leads Critical Buyers to Demand PARKER-KALON

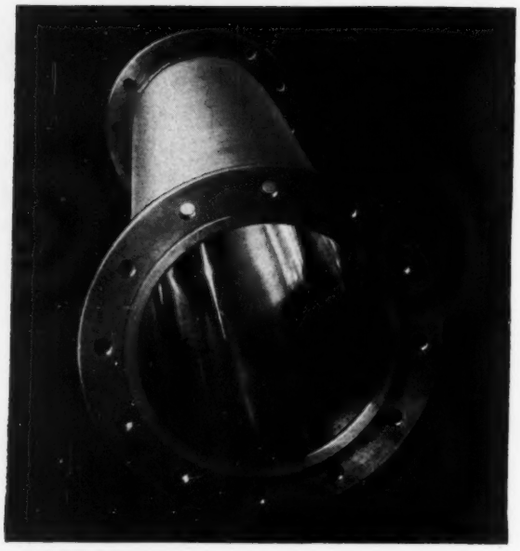
This torsion test is only one of 16 check-ups on important characteristics of Parker-Kalon Cold-forged Socket Screws. In a laboratory without counterpart in the industry, quality is guarded by thorough tests and inspections covering:

1—Chemical Analysis. 2—Tensile Strength. 3—Ductility. 4—Torsional Strength. 5—Ability to take Shock Loads under Tension. 6—Resistance to Shock Loads under Shear. 7—Hardness. In addition, there is a rigid inspection of these essentials: 8—Head Diameter. 9—Head Height. 10—Concentricity of Head to Body. 11—Socket Shape. 12—Socket Size. 13—Socket Depth. 14—Centricality of Socket. 15—Class 3 Fit Threads. 16—Clean Starting Threads.

In this way Parker-Kalon maintains a new higher standard of quality in Socket Screws . . . a standard that satisfies critical buyers. Send for free samples . . . see for yourself.

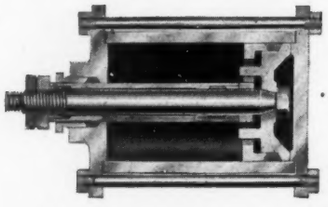
PARKER-KALON CORPORATION, 212 Varick Street, New York

PARKER-KALON Cold-Forged SOCKET SCREWS



Two Features

that mean high efficiency air cylinder performance



Hannifin "Leak-proof" air cylinders are bored and honed, regardless of size of bore or length of stroke, producing a straight, round, smooth cylinder finish.

The soft graphite-treated piston packing is adjustable from outside the cylinder, without disturbing any other parts.

The high efficiency piston seal prevents leakage and can be consistently maintained throughout the entire life of the packing. At the same time, perfect piston fit in a highly finished cylinder bore means minimum friction loss. Friction loss tests at 10 lbs. per sq. in., m.w.p. on 4½ in. diameter cylinders show Hannifin cylinders have less than 40% of the starting friction, and less than 30% of the moving friction of ordinary types of air cylinders.

Hannifin air cylinders are built in a full range of standard types, sizes 1½ to 16 in. diameter for any length stroke. Larger sizes built to order. Both single and double-acting types, furnished with or without air cushion. Write for Bulletin 34-MD with complete specifications.

●

HANNIFIN MANUFACTURING COMPANY
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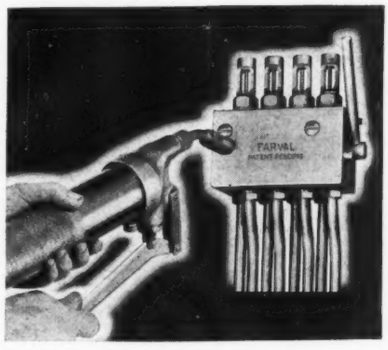
ENGINEERS • DESIGNERS • MANUFACTURERS
Pneumatic and Hydraulic Production Tool Equipment

HANNIFIN
IMPROVED AIR CYLINDERS

one hour at 200 degrees Fahr.; two hours at 175 degrees Fahr. The new finish has excellent gloss and build, print resistance, and retained flexibility. It is said to be wrinkle-proof under all normal conditions and gives satisfactory hiding in one coat when applied on solvent-cleaned steel, bonderited steel or primed steel. White and colors are available.

System Lubricates from One Inlet

A NEW system for lubricating small machines or several bearings on larger machines from a single grease inlet has been developed by The Farval Corp., Cleveland. The unit consists of a multiple measuring valve block with a single inlet port and from two to eight lubricant outlets per block. As many valve blocks as are necessary to lubricate all bearings on a machine can be installed and connected in series. The positive pressure lubrication of every bearing is accomplished by connecting a conventional type of hand or power grease



Small machines or several bearings on larger machines are lubricated from single grease inlet by system

gun to the grease nipple at the inlet port and moving the rotary valve handle. In one position lubricant pressure moves the valve pistons in one direction to deliver lubricant to one set of outlets. When the valve handle is moved to the opposite position, lubricant pressure moves the valve pistons in the opposite direction to deliver lubricant to the other set of outlets. Movement of the tell-tale indicator stem attached to each valve piston shows the oiler that each bearing has received its measured amount of lubricant.

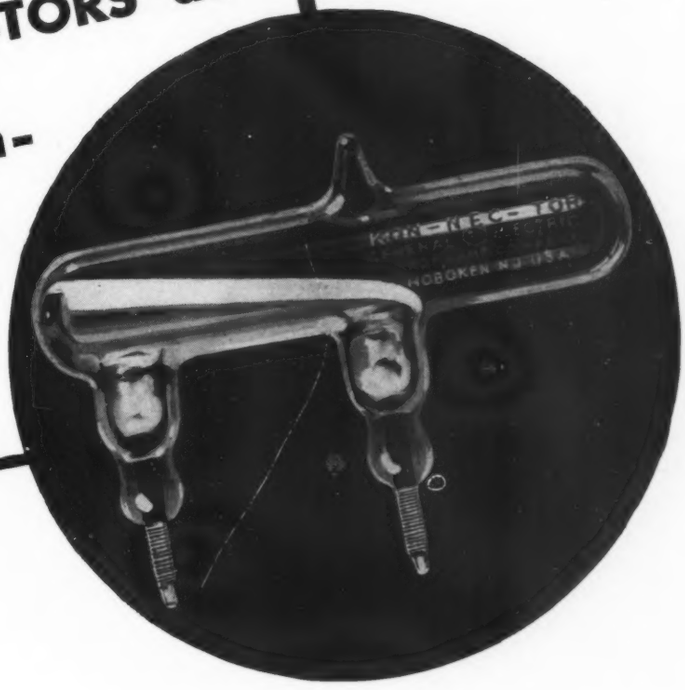
Switch Uses Mercury Button Contact

A NEW single-pole limit switch which uses a mercury-button contact mechanism to open and close the circuit has been announced by General Electric Co., Schenectady, N. Y. The new device is particularly suitable for use where the force available for operation of the switch is small, inasmuch as the only force required to operate the switch is that necessary to lift a light-weight molded lever or arm. The arm returns to its lower position by its own weight. Two corrosion-resistant metal hemi-

KON-NEC-TORS

"We've grown to look upon KON-NEC-TORS as practically indispensable"

...SAYS THIS MANUFACTURER



Specially-built machines for testing paper, thread, yarn, leather and numerous other materials are built by this manufacturer. They started using KON-NEC-TORS 12 years ago and, to quote them: "Almost every machine we make requires an automatic control of some kind, and for that purpose we have grown to look upon KON-NEC-TORS as practically indispensable.

"They are more often than not the very heart of the machine. We have found KON-NEC-TORS so reliable that we do not hesitate to send them out on machines going to Australia and many other distant lands. We know that KON-NEC-TORS will function indefinitely without failure."

Small wonder that an ever-increasing number of users swear by these positive-acting switches. KON-NEC-TORS are wholly glass-enclosed and are unaffected by corrosive gases and fumes. Contact is always clean and positive. They furnish absolute protection against sparking . . . are forever maintenance-free . . . and last indefinitely.

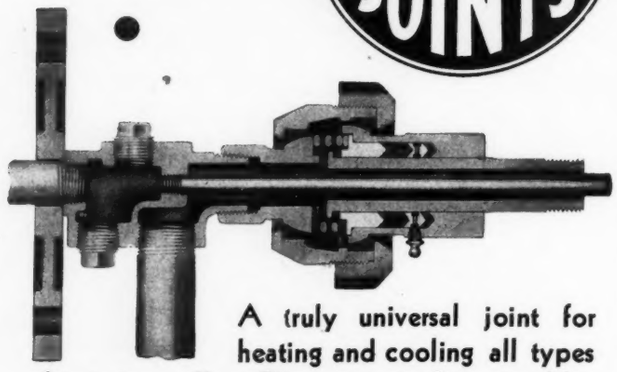
Complete details are included in the new KON-NEC-TOR bulletin No. 603. Write for a copy. General Electric Vapor Lamp Company, 825 Adams Street, Hoboken, New Jersey.

GENERAL ELECTRIC VAPOR LAMP COMPANY

364K

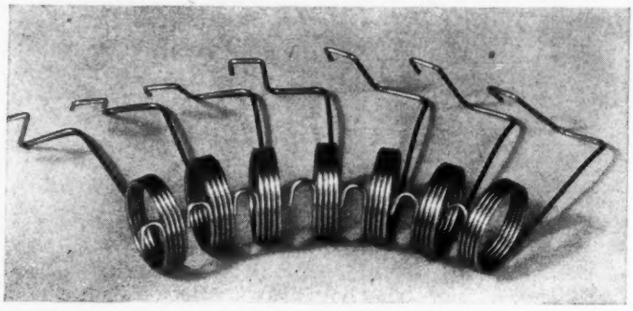
For efficient operation of revolving rolls and drums use Barco Revolving Joints.

BARCO REVOLVING JOINTS



A truly universal joint for heating and cooling all types of rotating rolls. Eliminates packing troubles due to strains in ordinary stuffing boxes.

Barco Manufacturing Co.
1820 Winnemac Avenue
CHICAGO, ILL.
In Canada: The Holden Co., Ltd.



"SLEEK!"

Though far from a shop term, "sleekness" aptly describes this job. In their uniformly wound coils, true diameters and accurate bends, these music wire torsion springs provide one more good example of what "Peck Service" offers those in search of dependable work at affordable prices.

THE PECK CATALOG

of springs and screw machine parts is close to being a designer's handbook. A request on company stationery will bring you one free of charge.

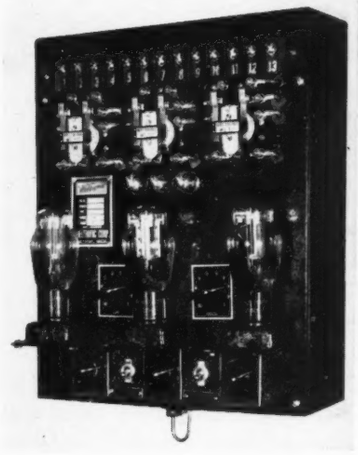
PECK SPRINGS
AND SCREW MACHINE PARTS

The Peck Spring Co., 10 Wells St. Plainville, Conn.

spherical shells separated by a special ceramic disk with an off-center hole make up the mercury-button element. The assembly is partially filled with mercury. An atmosphere of hydrogen prevents burning and corrosion. The unit is hermetically sealed with a glass ring so there is no question of maintenance. When the mercury button is rotated in the vertical plane, the off-center hole is raised out of the mercury, opening the circuit between the metal shells. Because of the tendency of the mercury to cohere, a positive, quick break is assured.

Electronic Timers Control Welding

DESIGNED for use with gun, spot, projection and automatic welding equipment, a new line of electronic welding timers has been announced by Weltronic Corp., Detroit. Up to 600 spot welds per minute in regular production have been made with these new timers, comprising models ranging in application from single spots to multiple-automatic spot welding. Through the use of electronic tubes the number of moving parts is reduced so that only a single relay and one tube are now required for full automatic control of a welding machine. Among



Ranging in application from single to multiple spots, new line of electronic welding timers makes up to 600 welds per minute

the controls available are the following: Regulation of start of welding current; setting of cutoff time of welding current; "cooling" time control to regulate length of time electrodes will remain in contact with the work after current is off; number of interruptions of welding current during welding operation; length of welding time in cycles; time delay before welding current goes on after electrode pressure has been built up. The timers are available for standard voltages of 110, 220, 440 or 550 with current frequencies of 25, 50 and 60 cycles.

"K" Monel Metal Used in Bearings

A NEW line of bearings made of "K" monel metal in any size of ball, straight roller, or tapered roller types has been placed on the market

Announcing!

The NEW MODEL "22"

. . . Produces flatter blue prints than ever before, yet at speeds up to 24' per minute

Retaining all of the good points of the many machines developed to date, the Pease Model 22 combines with them new features which, for the first time, make high production speeds practical, economical and usable.

VARIABLE LIGHT CONTROL — Variable Light Control is one of the features exclusive with the Model 22. By means of switches controlled at the feed board, the operator can change the intensity of the lights to vary the exposure whenever desired, thus avoiding changing the speed as is necessary in other machines.

HORIZONTAL WATER WASH — Horizontal water washes eliminate both bleeding and paper distortion, thus making high speeds practical FOR THE FIRST TIME. The "puddling action" of horizontal washing wets the paper thoroughly without stretching and pulling it out of shape.

NINE DRYING DRUMS — Nine Drying Drums, properly distributed and individually controlled, deliver the paper absolutely dry and *exceptionally* smooth. Prints from the Model 22 when cut and trimmed lie flat and solid almost as sheets do in the jogger of a printing press.

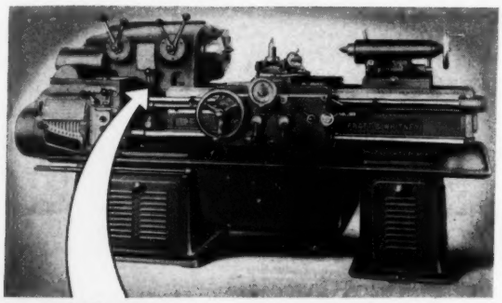
STREAMLINING — Model 22 is the first complete Blue Printing, Washing and Drying machine to be streamlined. Most of the unsightly parts are concealed with a trim sheet steel covering yet accessibility is accentuated. In fact, Model 22 is easier than ever to operate and to clean.

MANY OTHER FEATURES — The foregoing features and many others . . . such as the Quick-Change device for changing from potash to hypo instantaneously, a Safety Cutoff for each drum, more Actinic light than ever before, a convenient Cleanout Sump which will prevent plumbing bills, and a price that is right . . . combine to give in Model 22 the greatest value ever produced in such equipment. If you want the ultimate in quality and quantity blue print production you should have a Pease Model 22. Write today for complete details. No obligation. The C. F. Pease Company, 2606 West Irving Park Road, Chicago, Illinois.

P E A S E

Pullmore Clutches

Win Approval of Leading Machine Tool Builder



Double-Type Pullmore

Pullmore Clutches are made in single and double types, for operation in oil or dry, in capacities ranging from 1 h.p. to 75 h.p. at 500 r.p.m.

A double-type Pullmore Clutch, running in oil, is used for direct drive and brake to spindle in the Pratt & Whitney Lathe illustrated. This company "learned years ago that the performance of a machine tool is no better than its driving clutch" . . . uses Pullmore Clutches regularly in lathes and other machine tools.

Industrial Clutches

Our Over-Center and Spring-Loaded Clutches, for drives from internal combustion engines, are available in capacities up to 80 h.p. at 100 r.p.m. Investigate.

Pullmore Clutches are reliable, efficient, durable, compact, fit readily into machine designs for many kinds of industrial equipment. Write, today, for illustrated Pullmore Blue Book giving complete information.

ROCKFORD DRILLING MACHINE DIVISION

Borg-Warner Corporation, 304 Catherine Street, Rockford, Illinois

Sold by MORSE CHAIN CO., Ithaca, N. Y. With Offices in Principal Cities

★

An Old Friend at a New Price

KOH-I-NOOR

Drawing Pencils

NOW

10¢ each

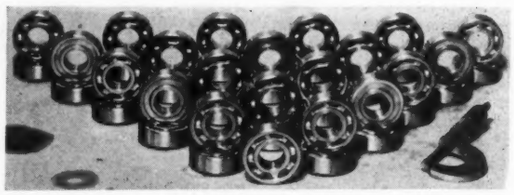
$1.00 per dozen

SEND FOR OUR LATEST CATALOG M-D 5

KOH-I-NOOR PENCIL COMPANY, Inc.

373 Fourth Avenue New York, N. Y.

by Bantam Bearings Corp., South Bend, Ind. All the characteristics of "K" monel, made by the International Nickel Co. Inc., are possessed by these bearings, the chief quality being nonmagnetism. Recording instruments will not be affected by "K" monel bearings because they can neither produce

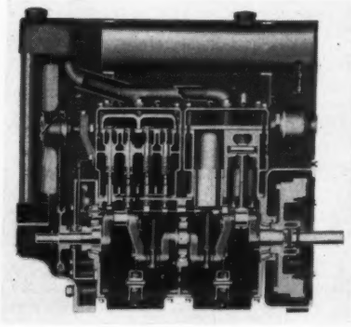


All sizes of ball, straight roller or tapered roller bearings are announced made of "K" monel

nor transmit magnetic fields. This feature is also of value for incorporation in machines handling flammable or explosive liquids and solids, where sparks ordinarily caused by friction may be a definite hazard. Other advantages of the bearings are acid and alkali resistance, and nonelectrolytic properties.

Engines Made for Heavy Service

FOR heavy duty service, a complete new line of ruggedly constructed single, two and four-cylinder radiator-cooled engines has been announced by the Novo Engine Co., Lansing, Mich. They range in size from two to 22-horsepower, and are known as the model CW engines. These power units are completely equipped with extra-large antifriction



Ranging in size from two to 22-horsepower, a new line of radiator-cooled engines is designed for heavy duty service

bearings and have heavy flywheels to assure smooth operation. Tapered roller bearings are used in the end position to carry thrust load. Gear oilers are positively driven from the crankshaft and guarantee engine lubrication as long as there is oil in the crankcase. Large oil and gasoline capacities allow long periods without attention.

Linestarter and Switch Combined

A NEW De-ion combination linestarter, consisting of a magnetically operated linestarter and a manually operated motor circuit switch combined in the same cabinet, is announced by the Westinghouse

GET YOUR PRODUCT READY

FOR A BETTER-PAYING JOB...

Products get ahead by getting heads. Presses, pumps, cameras, looms, vaults and vending machines will bear this up. For these products and many others have gone ahead—made more sales—with the help of "Heads for Figures"—Veeder-Root Counting and Computing Devices.

With built-in Veeder-Root Counting and Computing Devices you can make a machine do more. You can add extra features that lead to extra sales. You can make a product compute, record, remember, measure, count or control its work—all with these devices.

The applications of Veeder-Root Counting and Computing Devices are so unlimited and so diversified that it should pay the manufacturer of practically any product to read our interesting booklet "Counting Devices." This booklet contains many unusual success stories and shows what our engineers can do. It might have a "bright idea" for you. Write now for a free copy.

VEEDER-ROOT Inc.

HARTFORD..CONNECTICUT..U. S. A.

OFFICES IN Boston, Chicago, Cincinnati, Cleveland, Detroit, Greenville, S. C., Los Angeles, New York, Philadelphia, Pittsburgh, St. Louis, San Francisco, Montreal, Buenos Aires, Mexico City, London, Paris, Tokio, Shanghai, Melbourne

A reproduction of Model AC4, 4 Cyl. Air-cooled engine

•

Single and 4 Cyl. Models, 1 to 30 H.P.

. . . NO GREASE CUPS OR OIL FITTINGS ON THESE ENGINES

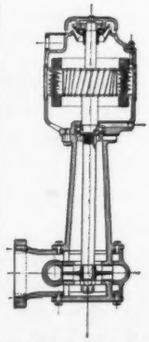
The only requirement — gas in the tank and oil in the crankcase. The engines will do the rest.

Write for specifications.

HEAVY DUTY AIR COOLED ENGINES by WISCONSIN MOTOR CORPORATION

WISCONSIN
MOTOR CORP., MILWAUKEE, WIS.

Model No. 11020A



Model No. 11022 Patented and Patents Pending

SIMPLIFY YOUR MACHINES

CHANGE TO

THE GUSHER COOLANT PUMP

The present trend is to simplify machine tools. Make them compact and really beautiful. Pipeless Gushers make this easy.

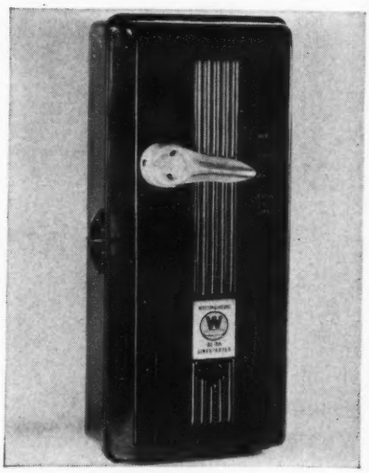
"Gusher" ball-bearing pumps are quiet—with split second control—are self-cleaning, hydrostatically balanced! More Gushers are used today than ever.

FOLLOW THE TREND— USE "GUSHERS"

Write for Engineering Specifications

THE RUTHMAN MACHINERY CO.
540 E. FRONT ST. CINCINNATI, OHIO

Electric & Mfg. Co., East Pittsburgh. It is especially designed for across-the-line starting of squirrel cage motors, or as primary switch for wound-rotor induction motors. In the safelocking design of handle and cabinet, insertion of one padlock locks the unit in "off" position and also locks the door. The door cannot be opened with the switch in "on" position. The

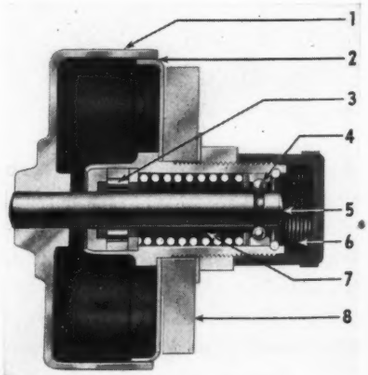


Magnetically operated linestarter and manually operated motor circuit are combined in same enclosed cabinet

starter has fuseless circuit protection, by an instantaneous magnetic trip circuit breaker, and there are no elements to renew after circuit tripping. Breaker is reset by moving external handle. The breaker handle is a positive indicator, showing whether breaker is "on," or "off," or "tripped."

Pulley Handles Light-Medium Belts

FOR light and medium duty high-speed belt drives, a new antifriction idler pulley has been developed by SKF Industries Inc., Philadelphia, after a similar unit proved widely acceptable in the textile industry. The ball and roller bearing idler pulley consists of a balanced standard or special pulley (1) which is provided with a dustproof protective cover (2) to form an effective seal. This seal eliminates all types of abrasive dust from the roller bearing (3) and the stabilizing ball bearing (4). These special bearings run directly on a through-hardened, chromium steel shaft (5), which gives

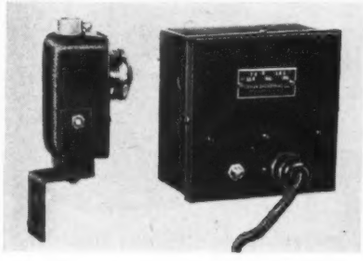


Antifriction idler pulley for light medium duty high-speed belt drives was first tested in textile industry

the unit a maximum capacity within its compact dimensions. The ball bearing (4) acts as an outboard bearing and insures surface-to-surface contact between the rollers and the shaft at all times. Grease cup (6) is provided so that a measured amount of grease may be placed in it every second year. Sufficient grease is initially placed in the large reservoir (7) to last two years.

Photoelectric Counter on Market

TYPE PC-3 high speed photoelectric counting equipment has been announced by the Lipman Engineering Co., 415 Van Braam street, Pittsburgh. The unit is capable of 600 counts per minute or 36,000 counts per hour. It is supplied complete with photoelectric amplifier and contact relay unit, light source with adjustable bracket, power supply control box



High speed photoelectric counting equipment is capable of 600 counts per hour

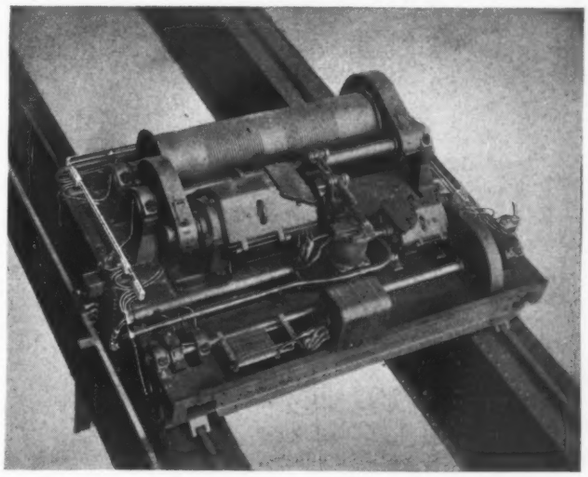
and counter in four or six-digit models. Polarized plugs are used for connections, permitting service or replacement of a unit in several seconds. Estimated tube life is 7000 to 10,000 hours. Power demand is 30 watts. The counter will function properly over a wide range of temperature and humidity and its operation is not materially affected by severe vibration.

Handwheel Adjusts Transmission

WITH handwheel control, a new series of "Select-O-Speed" transmissions is announced by the Ideal Commutator Dresser Co., 1059 Park avenue, Sycamore, Ill. These new models supplement the

New models of variable speed transmissions with handwheel control enable finer speed adjustments

standard line from fractional to 7½-horsepower capacity that are equipped with lever type control. The handwheel is recommended where finer speed adjustments and smaller increments of speed are nec-



FARVAL PREVENTS LOSSES due to faulty lubrication

Have you figured the cost of **NOT** *lubricating bearings properly?*

Since the production machines you build are your customers' first-line source of profit, any interruption to machine operation cuts directly into their earnings. One of the most frequent and costly of *all* interruptions—bearing troubles due to lack of lubrication—*can be avoided.*

FARVAL INSURES

Farval Centralized Systems of Lubrication *prevent* losses caused by faulty lubrication of bearings, by delivering the lubricant, in exact measured quantities, at proper intervals, to every bearing—missing none.

Furthermore, Farval *increases* the earning capacity of the machinery you build, by reducing power consumption; eliminating labor of oiling by hand; saving lubricant; reducing repair bills; and by prolonging the life of machines. All of which means that Farval makes your machines *more valuable* to your customers!

Help them *maintain* top production—install Farval and keep bearings fit. The Farval Corporation, 3265 East 80th Street, Cleveland, Ohio.

Affiliate of The Cleveland Worm & Gear Company, Manufacturers of Automotive and Industrial Worm Gearing

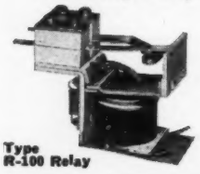
FARVAL

CENTRALIZED SYSTEMS OF LUBRICATION

Aesop said..

"little friends may prove GREAT FRIENDS"

No larger than the mouse that freed the lion—Relays by Guardian possess the power to solve many perplexing product design and assembly problems, where, like the lion's helpless hulk, the mechanical method is too awkward, too bulky, too slow and expensive to compare with efficient control assemblies using Relays by Guardian.



Type R-100 Relay

Use *Controls by Guardian*: small, compact stepping switches, contact switches, solenoids, time-delay, muting and holding relays—singly—or in innumerable combinations with discs, metal housings, brackets and special parts . . . every part designed, fabricated and tested in one plant . . . Guardian's!

Write for Catalog "D" Today! Now!

GUARDIAN ELECTRIC

1621 W. Walnut St. Chicago • Illinois

IT TAKES MORE THAN BRAWN— TO CRACK DIFFICULT PROBLEMS IN SPRINGMAKING

Raymond has over fifty years of reliable experience to put to work on your spring needs

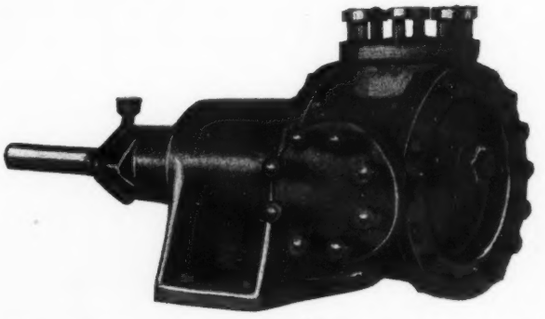
RAYMOND SPRINGS
WIRE FORMS
STAMPINGS

RAYMOND MFG. CO., DIV. OF ASSOCIATED SPRING CORPORATION
280 SO. CENTRE ST. · CORRY, PENNSYLVANIA

essary. By turning the wheel a partial turn, speed can be changed only a few revolutions per minute. This type of control is especially desirable for installations requiring remote control. By replacing the handwheel with a set of beveled gears and extension rod and universal joint, the point of control may be taken to any desired location.

Offer Three Hydraulic Pump Sizes

HYDRAULIC pumps in 50, 90 and 200-gallons-per-minute sizes are being offered by Viking Pump Co., Cedar Falls, Iowa. Like smaller Viking hydraulic pumps, the units are built to perform under pressures up to 500 pounds per square inch on oil free from grit and abrasives. They have been popularly



Hydraulic pumps for heavy duty are built to perform under pressures up to 500 pounds per square inch with oil free from abrasives

accepted for hydraulic drives, controls, etc. All three pumps are of the heavy duty type construction. The 50-gallon size is equipped with inner and outer angular contact bearings locked to the rotor shaft and a roller type bearing in the idler gear. The 90 and 200-gallon sizes have inner pure radial roller bearings on the rotor shaft, thrust being carried on a duplex outer ball thrust bearing locked against a shoulder on the rotor shaft. Both these sizes are also equipped with roller type bearings in the idler. Hardened steel rotors and idlers are used throughout. Casings and heads are nickel iron. All three pumps are built in the right-angle port design.

Address of Micro Switch Corp., Freeport, Ill., was incorrectly given as Peoria, Ill., in the March issue of MACHINE DESIGN, page 48. The error is regretted.

Meetings and Expositions

May 13—

Eastern Photoelasticity conference. Ninth semiannual conference to be held at Cornell university, Ithaca, N. Y. Prof. F. G. Switzer of the College of Engineering, Cornell University, Ithaca, N. Y., is chairman.

May 15—

Gray Iron Founders' Society Inc. Annual meeting

to be held at Netherland-Plaza hotel, Cincinnati, O. C. I. Ritchie, 1010 Public Square building, Cleveland, is executive secretary.

May 14-16—

Society of the Plastics Industry. Spring meeting to be held at Westchester Biltmore Country Club, Rye, N. Y. William Kelly of Chicago Molded Products Corp., 2149 Walnut street, Chicago, is secretary-treasurer.

May 14-18—

National Electrical Manufacturers' association. Spring conference to be held at Hot Springs, Va. W. J. Donald, 155 East 44th street, New York, is secretary.

May 15-17—

American Gear Manufacturers' association. Annual meeting has been changed from May 22-24, as reported previously, to the above and will be held at Cavalier Hotel, Virginia Beach, Va. J. C. McQuiston, 602 Shields building, Wilkinsburg, Pa., is manager-secretary.

May 15-18—

American Foundrymen's association. Annual convention to be held in Cincinnati. R. E. Kennedy, 222 West Adams street, Chicago, is secretary.

May 22-23—

American Society of Refrigerating Engineers. Annual meeting to be held at Hotel Hershey, Hershey, Pa. Additional information may be received from headquarters at 37 West 39th street, New York.

May 22-28—

World Automotive Engineering Congress. To be held in Hotel Pennsylvania, New York; at Indianapolis, May 29-30; at Hotel Statler, Detroit, May 31-June 2; and at Hotel Fairmont, San Francisco, June 6-8. Further information may be obtained from the Society of Automotive Engineers, 29 West Thirty-ninth street, New York.

May 24-26—

Association of Gas Appliance and Equipment Manufacturers. Annual convention to be held at Roosevelt Hotel, New York. Further information is obtainable at headquarters, 60 East Forty-second street, New York.

May 25—

American Iron & Steel institute. General meeting to be held at Hotel Waldorf-Astoria, New York. Walter S. Tower, 350 Fifth avenue, New York, is executive secretary.

June 19-22—

American Electro-Platers' Society. International convention to be held at Asbury Park, N. J. W. J. R. Kennedy, 90 Maynard street, Springfield, Mass., is executive secretary.

MACHINES . . .

of all types and sizes are designed by readers of Machine Design.

This field embodies:

Adding machines
Addressing & mailing machines
Agricultural machinery
Air conditioning equipment
Aircraft (airplanes, seaplanes & amphibians)
Automobiles (see Motor Vehicles)
Bakery machinery & equipment
Baling presses
Blowers & fans
Blueprinting & drafting machines
Bookbinding machinery
Bottling machinery
Calculating & counting machines
Cameras (including motion picture) & projectors
Canning machinery
Card-punching, sorting & tabulating machines
Cars & trucks, industrial & mining
Cash registers
Cement & concrete machinery
Centrifuges—separators
Change-making machines, taxi meters and ticket-counting machines
Check-writing machines
Chemical machinery
Clay-working machinery, brick, pottery, etc.
Clocks, time recorders & watches
Clothes-pressing machines
Coffee-roasting & grinding machines
Coin-operated machines
Condensers, other than electrical
Confectionery & ice-cream machinery
Conveying machinery including elevators and escalators
Cotton ginning machinery
Cranes, including hoists & derricks
Crushing, grinding & pulverizing machinery
Dairy, cheese factory & butter factory machinery
Dental machinery
Diesel engines
Dish-washing machinery
Dredging & excavating machinery including power shovels
Duplicating machines
Electric motors & generators
Electric & pneumatic portable tools
Electric razors and hair clippers
Electrical equipment (instruments, controls, relays, etc.)
Elevators (storage) & elevator machinery, including grain, flour & feed
Engines, steam & internal combustion
Fare registers & boxes
Firearms
Flour-mill & grain-mill machinery
Foundry machinery
Gas machines
Gas regulators
Glass-making machinery
Grinding, buffing & polishing mchy.
Hat-making machinery
Hydraulic equipment, incl. pumps
Incandescent lamp-making machinery
Industrial ovens & electric furnaces
Inspection machinery
Kitchen mixers & allied domestic machines not otherwise classified
Labelling machinery
Laundry and dry cleaning machinery
Lawn mowers
Leather-working machinery not including shoe machinery
Locomotives, rail cars, etc.
Lubricating machines
Machine tools
Metalworking machinery
Meters, gas & water
Mining machinery, not incl. oil drilling
Miscellaneous (not classified elsewhere)
Motorcycles & bicycles
Motor vehicles, except motorcycles
Musical instruments
Oil burning equipment
Oil-mill machinery, cottonseed & other
Oil-well & oil refinery machinery
Optical machinery incl. telescopes, microscopes, etc.
Orecrushers
Packaging machines
Packing-house machinery
Paint making machinery
Paper-box machinery
Paper-mill & pulp-mill machinery
Permanent wave machines, hair-dryers, etc.
Pharmaceutical machinery
Photo-engraving machinery
Plastics molding machinery, including presses & accessory equipment
Pneumatic equipment, including compressors
Power presses, including hydraulic & forging hammers
Printers' machinery
Pumps & pumping equipment
Radios & television
Recording and control instruments, including pressure & temperature indicators
Refrigerating & ice machinery
Research equipment, including testing, balancing & precision measuring machines
Road-making machinery, other than concrete mixers
Rolling-mill machinery
Rubber working machinery
Scales & balances
Sewing machines
Ships & motorboats
Shoe machinery
Signs, advertising & electrical
Slicing machinery
Special machinery
Stapling & wire stitching machinery
Stokers, domestic & industrial
Stone-working machinery
Sugar-mill machinery
Textile machinery
Tobacco manufacturing machinery
Toys, amusement machines & playground equipment
Transmission machinery
Turbines
Typewriters
Vacuum cleaners
Washing machines & clothes wringers
Welding machines, electric & other
Well-drilling machinery
Windmills & towers
Woodworking machinery
X-ray, therapeutic & hospital

MACHINE DESIGN

The Professional Journal of Chief Engineers and Designers

WALDRON *Flexible* COUPLINGS

a Type and Size for Every Purpose

GEAR TYPE Standard Torque Ring
FRANCKE Standard Marine
SPECIAL Types

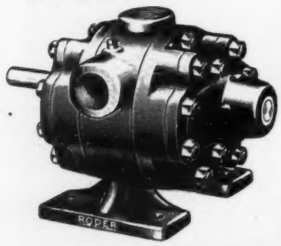
Most complete line of forged steel couplings for all drives, all loads. Advanced design and construction improvements insure trouble-free operation. Low initial cost. Write for catalogs giving sizes, service factors, prices. No obligation.

Manufactured by
JOHN WALDRON CORP.
NEW BRUNSWICK, N. J.
SALES REPRESENTATIVES IN PRINCIPAL CITIES

Faithful

Always trustworthy . . . always ready to start and finish a pumping job with the highest degree of efficiency. That's Roper Pumps!
They are engineered and built with a minimum of working parts, a stamina that assures years of service, and a smooth freedom that sets a higher maximum for speed.
If you are already using Roper Pumps, you know of their money-saving, always-on-the-job efficiency . . . if you're not using Ropers, won't you let us tell you how they operate with a lower power consumption and reduce costs to the lowest possible level?

WRITE FOR BULLETIN R5MD



ROPER

Rotary PUMPS

GEO. D. ROPER CORP., ROCKFORD, ILL.

MANUFACTURERS' *publications*

ALLOYS (HARD-SURFACING) — "Products of Haynes Stellite Company—Tables of Physical, Mechanical and Chemical Properties" is an attractive new booklet published by Haynes Stellite Co., Kokomo, Ind. It has value for designers of equipment parts which must withstand wear, abrasion, impact or chemical corrosion.

ALLOYS (NICKEL)—The International Nickel Co. Inc., New York, has issued revised bulletin T-5, containing information on the mechanical properties of monel metal. Mechanical property ranges of standard products are listed along with discussions of other properties of the metal in various conditions.

CONTROLS (ELECTRICAL)—The frequency relay magnetic method of control for alternating current wound-rotor motors is described in a new illustrated booklet published by Electric Controller & Mfg. Co., Cleveland. Colorful, easy to read, the booklet explains the method fully and cites a number of possible applications for it.

CONVEYORS—A comprehensive catalog, No. HB39, has been published by the Mathews Conveyer Co., Ellwood City, Pa., giving engineering information of all kinds pertaining to conveyors. In 384 pages it contains material of particular interest for designers concerned with incorporating conveying systems in large units. Diagrams and pictures fill much of the space. Distribution is limited to engineers and similar key men.

DRIVESHAFTS (FLEXIBLE)—Catalog Ind. 1939 has been published by Mechanics Universal Joint division, Borg-Warner Corp., Rockford, Ill., covering the company's roller bearing universal joints and flexible driveshafts for automobiles, trucks, and many kinds of industrial machinery. Specifications, photographs and cross-sectional drawings are included.

ENAMEL—A 24-page pictorial and technical report in color, called "From a Cleveland Laboratory," has been released by the Sherwin-Williams Co., Cleveland, describing Kem Lustral enamel, a versatile finish applied to wood or metal surfaces.

FITTINGS—The Pyle-National Co., Chicago, has issued two new bulletins, Nos. 207 and 1105, covering new lines of conduit fittings, known as Pylets. No. 207 is brief, colorful, pointing out features of these fittings; No. 1105 gives specifications, prices and applications.

GEARS, SPEED REDUCERS—Ohio Gear Co., Cleveland, has just published catalog No. 39 covering its gears, speed reducers, sprockets, chain, etc. For convenience, an index tab at the edge of pages gives quick references to information on any parts. Dimensions of gears, prices, and various engineering tables are included.

LIGHTING—Title of a new bulletin published by General Electric Co., Nela Park, Cleveland, is "Lighting for Production in the Factory." It discusses plant and engineering department lighting in terms of new knowledge of seeing. Equipment is described and various recommendations are made to secure improved vision.

LUBRICATION—Catalog No. 76 published by Bowen Products Corp., Auburn, N. Y., describes the Bowen electric automatic system of lubricating machinery. Schematic diagrams in the book help to set forth features of the system.

PISTON RINGS—Fourth edition of its engineers' piston ring handbook has been published by the Koppers Co., American Hammered Piston Ring division, Baltimore. This practical manual of 158 pages gives recommended types, specifications and applications of American piston rings for designers concerned with all types of engines. Illustrations are lavish and the handbook is a cleancut printing job. Requests for copies on company letterheads will be welcomed by the Koppers Co.

PULLEYS (VARIABLE SPEED)—Lewellen Mfg. Co., Columbus, Ind., has just published illustrated catalog No. 40 describing the Lewellen variable speed motor pulley. Besides a discussion of features of the pulley, the catalog gives rating tables listing proper pulley sizes to be used with motors of different horsepower, and gives length of belt in each case.

PULLEYS (VARIABLE SPEED)—The Speedmaster Co., division of Continental Machines Inc., 1301 Washington avenue South, Minneapolis, has published an illustrated folder covering the Speedmaster variable speed pulley for use with standard V-belts. Construction and operation of the pulley are explained diagrammatically.

PUMPS—Economy Pumps Inc., 1000 Weller avenue, Hamilton, O., has just issued its 1939 pump data book. First half of this 256-page book offers pump prices, applications and installation data; second half is devoted to engineering data of interest to designers. Virtually all phases of subjects connected with pump installation are covered.

PUMPS—In bulletin S-10, issued by The East Shore Machine Products Co., 833 East 140th street, Cleveland, is a description of the features of the "self take-up of wear" gear pump. A large cross section shows the "taper principle" of the unit and other

TESTIFYING TO OPERATING SUPERIORITY

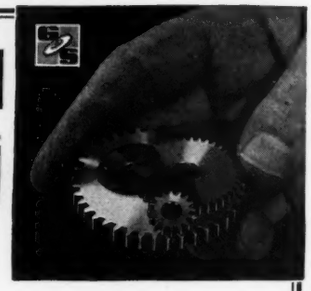
The D. O. James organization maintains equipment and machinery for the making of all types of gears and gear reducers — operated by men who are trained gear specialists and under a supervision which has the ability and will to understand your problems and help you solve them.

The "candids" of Mac, Bill and Gus depict the alertness that typifies a D. O. James mechanic. Each of them have over 20 years of experience with our organization. Many more of these gear veterans in our employ. They . . . we . . . welcome the opportunity of serving you.

D. O. JAMES
MANUFACTURING CO.
Established 1888
1120 W. Monroe St., Chicago

BRANCH OFFICES IN IMPORTANT KEY CENTERS

D.O.JAMES



SMALL GEARS

in the finer pitches 14 to 96 D. P.

SPURS—SPIRALS—BEVELS
WORM GEARING

The manufacture of your small Gears, such as these and other types, should be intrusted to SPECIALISTS in this range . . . Send your prints to—

Made to order only *No stock* *No catalog*

Gear Specialties
INCORPORATED
CHICAGO

2670 W. MEDILL AV. Phone, Humboldt 3482

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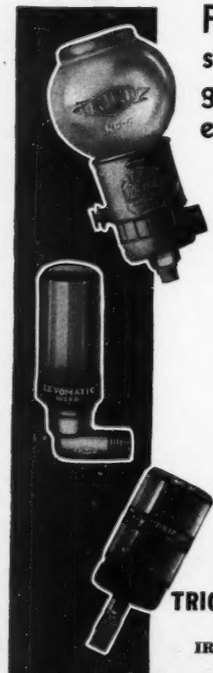
REG. U.S. PAT. OFF.



For maintaining a constant level of oil in bearings, gear housings, line shafts, etc.

- They modernize your equipment
- Give that added sales feature
- Reduce selling resistance
- Guarantee proper lubrication of your equipment after it leaves the factory
- Places you a step ahead of your competitor who still thinks the old-fashioned oil can method is good enough.

Write for your FREE copy of booklet on "Visible Automatic Lubrication"

TRICO FUSE MFG. CO., Milwaukee, Wis.

In Canada
IRVING SMITH LIMITED,
Montreal

WRITE FOR LITERATURE

features are set forth clearly and concisely. Prices are given.

RESISTORS—Instructions for the manufacture and care of grid type resistors for direct and alternating current motors, and a suggested auxiliary set of renewal parts, are contained in a new leaflet, 1734-B, published by Westinghouse Electric & Mfg. Co., East Pittsburgh. Included is a table indicating the rating of the resistors and the starting torque and current to be obtained on the first point of the controller in per cent of full load.

SHEAVES (VARIABLE SPEED)—New bulletin No. 1261-B has been issued by Allis-Chalmers Mfg. Co., Milwaukee, on Vari-Pitch Texrope sheaves. The bulletin illustrates and describes the stationary control type for occasional changes of speed and the motion control type for use where frequent speed changes are necessary. Dimension sheets and a number of installation photographs are included.

STACK-CUTTING—Designers will find ideas for production of parts in a recently-published booklet entitled "Stack-cutting Speeds the Production of Identical Parts." Issued by The Linde Air Products Co., New York, the book tells how large quantities of simple or intricate shapes can be produced from piled sheets or plates of steel by the oxyacetylene cutting process.

STEEL—Vol. 1, No. 1 of *Steel Horizons* has been published by Allegheny Ludlum Steel Corp., Pittsburgh. *Steel Horizons,* a large, lavishly illustrated magazine, contains articles on the use of Allegheny-Ludlum steel as well as information on steel in general. Center spread is an elaborate two-page pictorial layout showing a number of machines in which effective use of steel is made for cabinets, housings and other exterior purposes.

STEEL—Crucible Steel Co. of America, 405 Lexington avenue, New York, has published the No. 1, Vol. II issue of its organ, *Crucible News.* A number of articles relating to steel and its uses is contained, as well as contributions from representatives.

STEEL (LEAD-BEARING)—A new bulletin of Joseph T. Ryerson & Son Inc., Chicago, describes Ledloy open hearth steels carried by Ryerson. Improved machinability and increased tool life are said to be possible with these steels, available in a wide range of analyses. Results of actual machining tests are included in the bulletin.

TUBING (FLEXIBLE)—Resistoflex PVA flexible tubing, impervious to oils and organic solvents, is discussed in an illustrated folder in color issued by Resistoflex Corp., 370 Lexington avenue, New York. Details facilitating use of the tubing, such as fittings, tube sizes, temperature range, elasticity are given.

Business and Sales Briefs

RECENT announcements made by Foote Bros. Gear & Machine Corp., include the appointment of G. T. Luippold, 1115 South Hope street, Los Angeles, as district representative and sales engineer, and that of A. C. Hanson as district representative and sales engineer for the Detroit territory, replacing Everett G. Akridge.

♦

John C. Chaffe, who has been associated with Republic Steel Co. since 1931, has been appointed district sales manager of the Philadelphia territory. Prior to 1931 Mr. Chaffe was vice president of Wrought Iron Co. of America, Lebanon, Pa.

♦

After fifty-five years of continued service in the sales department of the Scovill Mfg. Co., Waterbury, Conn., George T. Power has recently retired. His position before retirement was that of district manager of the company's New York office.

♦

Previously with Quarmstrom Tool, Detroit, Carl Holmes has become associated with the plastics industry in his new connection with R. H. Freitag Co., Akron, O. This company has recently enlarged its plastic die division.

♦

Graham Transmissions Inc. has recently become a part of Briggs & Stratton Corp., 2711 North Eleventh street, Milwaukee, which will manufacture and sell the products previously produced under the name of the former company. Mr. Graham is now associated with the Briggs & Stratton organization.

♦

Announcement has been made of a change in address of the Philadelphia office of Ward Leonard Electric Co., Mount Vernon, N. Y. The new location is Room 329, 1600 Arch street. Frank Beede, formerly of the Chicago office and for several years attached to the sales engineering department at the factory, is district manager.

♦

W. P. Woodside, vice president of Climax Molybdenum Co., New York, has replaced John W. Miner as director of Reynolds Spring Co., Jackson, Mich. Mr. Miner resigned recently.

♦

Hydro-Power Systems Inc. has recently been organized to manufacture and develop hydraulic machine drives and their component parts—radial pumps, gear pumps, valves and controls. With complete manu-

VARIABLE SPEED At LOW COST!

IDEAL "Select-O-Speed"

THE "MILLION SPEED" TRANSMISSION USES STANDARD V-BELTS

NOW! **You can include Variable Speed Transmissions in the design of *your* machinery. *Low Price* and *Compact Size* have made the *Ideal "Select-O-Speed"* practical for *Thousands of Uses* where high cost installations have previously made it impossible to use a Variable Speed Transmission.**

Inexpensive **SIZES UP TO 7½ H.P.**

Everything You Want In A Transmission

1. **Extremely low cost.**
2. **Sizes from fractional to 7½ H.P.**
3. **Uses Standard V-belts.**
4. **Infinite speed selection over 5-to-1 range (Higher ranges on some sizes).**
5. **Instant speed changes made while machine is in operation.**
6. **Extremely simple design—minimum of wearing parts—no gears or driving chains—few moving parts—ball bearing throughout.**
7. **Compact, lightweight — easily installed on small or large machines.**
8. **No noise or vibration.**
9. **Belts *always* in correct alignment and at normal tension.**
10. **Working parts enclosed for safety and protection from dirt and dust—shipped completely assembled, ready for use.**
11. **Choice of Control—either hand wheel or lever control available on sizes from 1½ to 7½ H.P. Hand Wheel type provides extremely fine adjustments.**
12. **Performance, workmanship and parts, fully guaranteed.**

The *Ideal "Select-O-Speed"* has already become standard equipment in hundreds of plants. You'll make a big hit with your customers if you give them *"Select-O-Speed"* as part of their NEW equipment.

Let our experienced Transmission Engineers show you how easy it is to adopt the "Select-O-Speed". Write us today!

Transmission Division

IDEAL COMMUTATOR DRESSER COMPANY

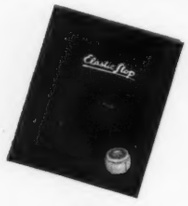
1059 Park Avenue **Sycamore, Illinois**

FILLING THE BILL

It's the combination of compactness with capacity that makes Tuthill Small Pumps first choice of design engineers. Maximum capacity is built into this dependable pumping equipment to take care of all your small pump requirements. Wide range of capacities, pressures and mountings.

Write for Small Pump Catalog today

TUTHILL PUMP COMPANY
941 EAST 95TH STREET, CHICAGO, ILLINOIS



GET THE WHOLE STORY about the self-locking nuts that are revolutionizing fastening practices . . . .

THIS BOOK is more than a catalog. Besides showing the many types and sizes of Elastic Stop Nuts available, it explains the Elastic Stop principle, gives comparative test data, shows methods of application, and illustrates uses in numerous industries.

Every designer should have it in his file. *Write for your copy now.*

THE NUT WITH THE RESILIENT NON-METALLIC LOCKING COLLAR

Many types . . . All sizes . . .
All thread systems . . . Any material

ELASTIC STOP NUT CORPORATION
1011 NEWARK AVENUE · ELIZABETH, NEW JERSEY

Elastic Stop SELF-LOCKING NUTS

facturing and engineering facilities, the company will be located at Mount Gilead, Ohio. The new company, which is the outgrowth of broad experience in development and application of hydraulic drives to H-P-M Fastraverse presses during the past fifteen years, will devote its efforts to application of hydraulic drives to new machines and to the replacement field.

♦

The sales organizations of Robertshaw Thermostat Co. and the American Thermometer Co. have been consolidated, according to a recent announcement by John A. Robertshaw, vice president and general manager, to increase the effectiveness and facilities of a sales-engineering service. Formerly sales manager of the Robertshaw company, H. T. Ryan has been elected vice president and assumes managerial duties relating to the activities of the two concerns; and T. T. Arden, previously sales manager of the American Thermometer Co., has been named sales manager in charge of domestic appliance control sales.

♦

Since 1937 a member of the Dallas, Tex., sales office, W. F. Pravel, who has been with the Allegheny-Ludlum Steel Corp. five years, has been appointed district sales manager of the Houston, Tex., territory of the company.

♦

L. W. Greve, president of Cleveland Pneumatic Tool Co., has been elected a director of Cleveland Graphite Bronze Co.

♦

Formerly with Hoskins Mfg. Co., Roger Waindle has now been named sales manager of Fahralloy Co., Harvey, Ill.

♦

Formerly vice president in charge of sales of Belden Mfg. Co., Whipple Jacobs now becomes president. He succeeds Joseph C. Belden, founder of the company, who died recently. Mr. Jacobs has served with the company 24 years, going through the ranks of inspector, chief inspector, purchasing agent, sales manager and vice president.

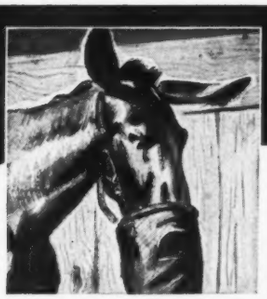
♦

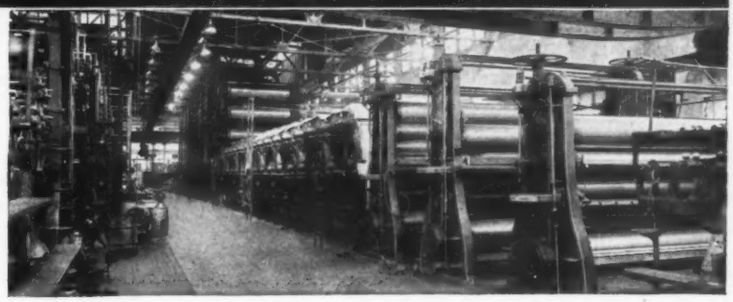
Establishment of the Plastic Products Manufacturers Association Inc., with headquarters at 1133 Broadway, New York, has been announced by Abraham Edelman, executive director. Among others, the main purpose of the association is to promote, develop and improve business standards within the industry, create and maintain standards of fair competition and set up means of administering them.

♦

For the past two years Western New York representative of Maas & Waldstein Co., Floyd M. Erlenmeyer has been transferred to the southern New York territory. Mr. Erlenmeyer, who has had wide experience in both the manufacture and application of industrial finishes, will make his headquarters in New York city.

Eating its Head off in Idleness





IDLENESS of production machinery, caused by failure of driving equipment, adds sharply to manufacturing costs and digs deeply into profits. Many of these failures, tie-ups, and delays can be eliminated by incorporating long-lived INSUROK gears and bearings into machine design. They assure uninterrupted performance, cut power consumption and reduce unit costs. The services of Richardson engineers are available without cost or obligation. Consult them freely about any problem of design involving the use of gears and bearings that must function under difficult conditions.

Eliminate Production Delays with

INSUROK

PLASTIC GEARS AND BEARINGS

The RICHARDSON COMPANY

Melrose Park, (Chicago) Ill. Founded 1858 Lockland, (Cincinnati) Ohio
New Brunswick, N. J. Indianapolis, Ind.
Detroit Office: 4-252 G. M. Building, Phone Madison 9386
New York Office: 75 West Street, Phone Whitehall 4-4487

LEIMAN BROS. NEW

SURFACE GRINDER DUST COLLECTOR

For Your Grinder of Whatever Make

A Complete Motor-Driven Unit at Small Cost

This small, yet powerful, machine occupies but 11" x 13" space. It consists of a sturdy, powerful suction blower, electrically driven, with piping connections to the surface grinder and to the high grade dust disposal bag.

It can easily be placed on the floor or a shelf on a nearby pillar or wall, out of the way. It can be plugged into any lamp socket.

The strong suction of air draws away all the light metallic and light abrasive dust created when grinding. This highly irritating dust is caught in a bag made of specially treated filter cloth which may be quickly emptied when necessary.

Don't Breathe Grinding Dust!

"The direct cause of silicosis is the inhalation of minute particles of silica dust. While the type of pulmonary lesion depends on the particular dust inhaled, the underlying pathological principle is the same in all forms of the disease, viz., an ultimate fibrosis and replacement of the elastic lung tissue by a hard unyielding fibrous tissue."

SILICOSIS IS INCURABLE!

GET FREE INFORMATION AND FOLDER ABOUT THE DANGERS OF DUST

LEIMAN BROS., Inc., SG23-P WALKER ST. NEW YORK CITY

MAKERS OF GOOD MACHINERY FOR 50 YEARS

DEVOTED TO PLASTIC MOLDING

You are cordially invited to call and inspect this great new Custom Molding Plant.

Here you will find a spacious well equipped tool room manned by expert mechanics of long experience in mold making—a full complement of presses for both compression and injection molding—a finishing department geared to fast, accurate, economical production, and above all an engineering staff of unsurpassed ingenuity and ability ready to cooperate with you on your molding problems.

CHICAGO MOLDED PRODUCTS CORP.

1028 No. Kolmar Ave. Chicago, U. S. A.

Sales Representatives

510 Stephenson Bldg. Detroit, Mich.	1225 No. Water St. Milwaukee, Wis.	211 E. 14th St. Kansas City, Mo.
610 Plymouth Bldg. Minneapolis, Minn.	3625 College Ave. Indianapolis, Ind.	3650 Dover Place St. Louis, Mo.

NEW MACHINES—
And the Companies Behind Them

(For illustrations of other outstanding machinery see Pages 44-45)

Agricultural

Dredger, Bucyrus-Erie Co., South Milwaukee, Wis.
Diesel tractor, International Harvester Co., Chicago.
Sugar cane harvesting machine, R. G. LeTourneau Inc., Peoria, Ill.

Air Conditioning

Automatic burner, Fairbanks-Morse & Co., Chicago.
Floor-type unit heater, American Gas Products Div., American Radiator & Standard Sanitary Corp., New York.
Unit heaters, John J. Nesbitt Inc., Holmesburg, Philadelphia.
All-steel heat-generator boiler, Harvey-Whipple Inc., Springfield, Mass.

Bakery

High-speed bread slicer, Battle Creek Wrapping Machine Co., Battle Creek, Mich.

Confectionery

Deluxe ice cream cabinet, C. Nelson Mfg. Co., St. Louis.
Frozen malted machine, Florida Frostee Machine Co. Inc., Miami, Fla.
Refrigerated electric bottle coolers, S & S Products Co., Lima, O.
Popcorn vendor, Bally Mfg. Co., Chicago.

Dairy

Automatic milker, Anker-Holth Mfg. Co., Port Huron, Mich.

Domestic

Radios and refrigerators, Philco Radio & Television Corp., Philadelphia.
Vacuum cleaner, General Electric Co., Bridgeport, Conn.
Folding traveling iron, Chicago Electric Mfg. Co., Chicago.
Washer, Crosley Corp., Cincinnati.
Stoker, Link-Belt Co., Chicago.
Television receiver models, General Electric Co., Bridgeport, Conn.
Electric roaster, The Swartzbaugh Mfg. Co., Toledo, O.
Electric steam iron, Steam-O-Matic Corp., Milwaukee, Wis.
Electric light plants, D. W. Onan & Sons, Minneapolis.

Finishing

Stainless steel polishing machine, Excelsior Tool & Machine Co., East St. Louis, Ill.

Excavating

Chain drive trucks, Hug Co., Highland, Ill.
Crawler-mounted shovel, Thew Shovel Co., Lorain, O.
All-purpose, three-speed hoist, Clyde Iron Works Inc., Duluth, Minn.

Furniture

Chain saw and chisel mortising and boring machine, Bell Machine Co., Oshkosh, Wis.

Industrial

Floor scrubbing machine, Hild Floor Machine Co., Chicago.
Pressure lubrication gun, Pressurelube Inc., New York.
Vibrating screen, Link-Belt Co., Chicago.
Portable blower, Skilsaw Inc., Chicago.
Ventilating equipment, South Bend Air Products Inc., South Bend, Ind.
Heavy-duty cleaner, Electric Vacuum Cleaner Co. Inc., Cleveland.

Laundry

Sleeve presser, The Prosperity Co. Inc., Syracuse, N. Y.
Laundry iron, J. W. Steele & Co., North Kansas City, Mo.

Oil Mill

Cotton pellet mill, Helm Mfg. Co., Fort Worth, Texas.

Packaging

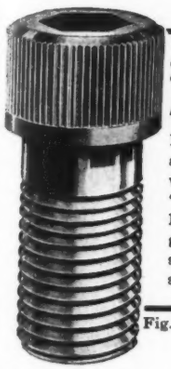
Weigher-filler machine, Triangle Package Machinery Co., Chicago.
High-speed automatic labeling machine, The Oslund Bros. Machine Co., Worcester, Mass.
Shipping case opener, J. L. Ferguson Co., Joliet, Ill.
Twelve-station soup filler, Sprague-Sells Div., Food Machinery Corp., Hoopeston, Ill.
Bottle filling and capping machine, Girton Sales Co., Millville, Pa.
Jar-filling machine, Karl Kiefer Machine Co., Cincinnati.
Speed wrap machine, Miller Wrapping & Sealing Machine Co., Chicago.

Petroleum

Drawworks, Continental Supply Co., Dallas, Tex.
Rotary drilling rig, Bridgeport Machine Co., Wichita, Kans.
Ditching machine, Buckeye Traction Ditcher Co., Findlay, O.
Portable engine-cooling units, Marley Co., Kansas City, Kans.

Controlled Lubrication is CLEAN!
The correct oil film to each individual bearing... automatically
"Saco-Lowell" Spinning Frame
SACO LOWELL
CLEAN . . . because the Bijur Automatic Lubricating System is a closed—metered—system . . . no drip, no drainage. On textile machines an essential protection against damaging contact of oil with roving, yarn, cloth! You save goods, oil, and the machine itself. The bearings of a BIJUR-equipped machine are protected for life. Continued smooth-working . . . maintenance and production costs reduced! Specify BIJUR.
Write for Bulletin "D"
BIJUR LUBRICATING CORPORATION, LONG ISLAND CITY, N. Y.
BIJUR
AUTOMATICALLY Correct LUBRICATION
944

Three Reasons Why it pays to specify the Cap Screws with the Knurled Heads



1. Speeds-up Assembly

Mechanics use fingers as much as possible when driving screws. "Unbrako" Knurled Heads give a better grip. Pliers bite without slipping. Production speeds up.

Fig. 1434

2. Easy to Lock after Counter-Sinking

An easily used locking tool makes locking after countersinking easy with Knurled "Unbrakos". It's an exclusive feature. Ask us how it's done.

3. Dolls up the Finished Job

The knurled heads on "Unbrakos" improve the appearance of any finished product on which they're used. That's the opinion of countless users.

U. S. and Foreign Pats. Pending

Specify . . . **KNURLED**

UNBRAKO

SOCKET HEAD CAP SCREWS

Write for sample screws. Examine them yourself to prove these facts.

STANDARD PRESSED STEEL CO.

BRANCHES BOSTON DETROIT INDIANAPOLIS

JENKINTOWN, PENNA.

BOX 102

BRANCHES CHICAGO ST. LOUIS SAN FRANCISCO

Wanted

BY MACHINERY MANUFACTURER

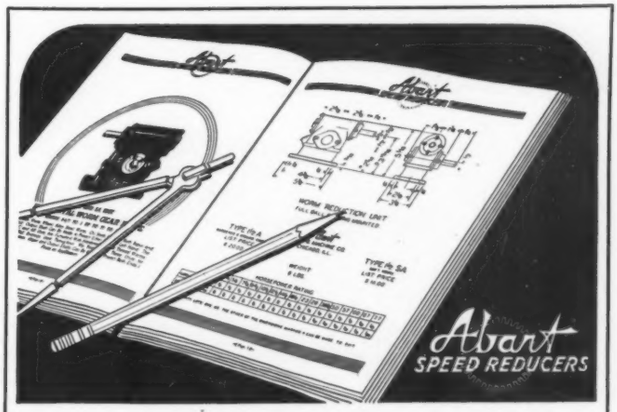
INVENTIONS WANTED: New York manufacturer wishes to contact engineer inventors with patented or unpatented inventions for small and medium sized equipment for chemical, oil refining and process industries. Will consider agitators, pulverizers, sifters, acid pumps, etc. No valves, gages or meters. Immediate manufacture and sale. Ideas should be simple, and have wide appeal. Prefer electric motor driven devices. Also interested in parts, fittings or devices of expendable nature for sale in good volume from stock. Address Box 116, MACHINE DESIGN, Penton Building, Cleveland, Ohio.

CLASSIFIED advertisements are set in eight point Stymie bold face type, approximately eight words to a line. Rates are as follows:

Positions Available—20c a word, with a minimum charge of $10.00, which permits the use of fifty words.

Positions Wanted—10c a word, with a minimum charge of $3.00, which permits the use of thirty words.

The box number will be counted as one line or eight words.



Select The Right Reducer From This Book

This new Abart Speed Reducer Catalog will give you the correct answer to your speed reducer problem quickly. In it you'll find information on ratings and other essential data that will help you select the most efficient type and style Abart unit for your job. Write for your catalog today.

GEARS

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INDEX TO ADVERTISERS

Abart Gear & Machine Co. 83
Alemite ..... *
Allen-Bradley Co. ..... *
Allis-Chalmers Mfg. Co. ..... Inside Front Cover
American Brass Co., The ..... *
American Cable Div., American Chain & Cable Co., Inc. ..... *
American Chain & Cable Co., Inc. ..... *
American Engineering Co. 51
American Metal Hose Branch, The American Brass Co. 18
American Screw Co. 74
American Steel & Wire Co. ..... *
Ampco Metal, Inc. ..... *
Associated Spring Corp. ..... *
Auburn Button Works, Inc. ..... *

Baldwin-Duckworth Chain Corp. 68
Bantam Bearings Corp. 82
Barco Manufacturing Co. ..... *
Bijur Lubricating Corp. ..... *
Bodine Electric Co. 49
Bond, Charles, Co. 3
Boston Gear Works, Inc. ..... *
Bound Brook Oil-Less Bearing Co. 57
Briggs & Stratton Corp. ..... *
Bristol Co., The ..... *
Brown & Sharpe Mfg. Co. ..... *
Bruning, Charles, Co., Inc. ..... *
Bunting Brass & Bronze Co., The ..... *

Carnegie-Illinois Steel Corp. 51
Cerro De Pasco Copper Corp. ..... *
Chain Belt Company 81
Chandler Products Co. 4
Chicago Metal Hose Corp. 64
Chicago Molded Products Corp. ..... *
Chicago Rawhide Mfg. Co. 19
Cleveland Worm & Gear Co. 51
Clifford Mfg. Co. ..... *
Columbia Steel Co. 51
Continental Roll & Steel Foundry Co. ..... *
Continental Screw Co. 51
Conway Clutch Co., The ..... *
Corbin Screw Corp. 63
Crocker-Wheeler Electric Mfg. Co. ..... Back Cover
Cuno Engineering Corp. 13
Cutler-Hammer, Inc. ..... *

Dayton Rubber Mfg. Co., The 55
De Laval Steam Turbine Co. ..... *
Delco Products, Division General Motors Corp. 11
Diamond Chain & Mfg. Co. ..... *
Dow Chemical Co., The 22
Drop Forging Association ..... *
Dumore Co., The ..... *
Du Pont, E. I., de Nemours & Co., Inc. 80

Eagle Pencil Co. ..... *
Eclipse Moulded Products Co. ..... *
Elastic Stop Nut Corp. 73
Electro Metallurgical Co. ..... *

Fafnir Bearing Co., The 21
Farval Corp., The ..... *
Federal-Mogul Corp. ..... *
Foote Bros. Gear & Machine Corp. ..... *
Foote Gear Works, Inc. ..... *
Formica Insulation Co., The 16

Galland-Henning Mfg. Co. 78
Garlock Packing Co., The 67
Gear Specialties, Inc. ..... *
General Electric Co. 74
General Electric Vapor Lamp Co. ..... *
General Radio Co. ..... *
Gibson, William D., Co. ..... *
Guardian Electric Co. 66
Guardian Utilities Co. ..... *

Hanna Engineering Works ..... *
Hannifin Manufacturing Co. ..... *
Hart Manufacturing Co., The ..... *
Hilliard Corp., The ..... *
Hyatt Bearings Division, General Motors Sales Corp. 14, 15
Hydro-Power Systems, Inc. 79

Ideal Commutator Dresser Co. ..... *
International Nickel Co., Inc., The ..... *

James, D. O., Mfg. Co. 77
Johnson Bronze Co. 58
Jones, W. A., Foundry & Machine Co. 70

Keuffel & Esser Co. ..... *
Koh-I-Noor Pencil Co., Inc. 51

Laminated Shim Co., Inc. 81
Lamson & Sessions Co., The ..... *
Leiman Bros., Inc. ..... *
Leland Electric Co., The ..... *
Lewellen Manufacturing Co. 86
Lima Armature Works, Inc., The 10
Lincoln Electric Co. ..... *
Linde Air Products Co., The ..... *
Link-Belt Co. ..... *
Logansport Machine, Inc. ..... *
Lovejoy Flexible Coupling Co. 56

McGill Mfg. Co. ..... *
Marlin-Rockwell Corp. ..... Inside Back Cover
Master Electric Co. ..... *
Michigan Tool Co. ..... *
Micro Switch Corp. ..... *
Monitor Controller Co. 51
Morse Chain Co. ..... *

National Acme Co. ..... *
National Screw & Mfg. Co. 6
National Tube Co., Division General Motor New Departure, Sales Corp. 8, 9
New Jersey Zinc Co., The 60
Norma-Hoffmann Bearings Corp. ..... *

Ohio Gear Co., The 51, 65
Oilgear Company, The 69
Ozalid Corporation 68

Parker-Kalon Corp. 51
Pease, C. F., Co., The ..... *
Peck Spring Co., The ..... *
Peerless Electric Co., The 74
Pheoll Mfg. Co. ..... *
Philadelphia Gear Works 81

Racine Tool & Machine Co. ..... *
Raymond Mfg. Co. 70
Reeves Pulley Co. 76
Richardson Co., The 51
Rivett Lathe & Grinder, Inc. 72
Rockford Drilling Machine Div. of Borg-Warner Corp. ..... *
Roper, Geo. D., Corp. 51
Russell, Burdsall & Ward Bolt & Nut Co. 17
Ruthman Machinery Co. ..... *

Scovill Mfg. Co. ..... *
Shafer Bearing Corp. ..... *
Shakeproof Lock Washer Co. 59
SKF Industries, Inc. 62
Speedway Mfg. Co. 83
Spring Washer Industry 85
Square D Co. ..... *
Staedtler, J. S., Inc. ..... *
Standard Pressed Steel Co. ..... 61, *
Steel Founders' Society of America ..... *
Stewart-Warner Corporation ..... *
Stow Manufacturing Co., Inc. ..... *
Sundstrand Machine Tool Co. Division, Sundstrand Pump Division ..... *

Tennessee Coal, Iron & Railroad Co. ..... *
Thompson-Bremer & Co. 53
Timken Roller Bearing Co. 78
Tomkins-Johnson Co., The 80
Torrington Co., The ..... *
Trico Fuse Mfg. Co. 10
Tuthill Pump Co. ..... *
Twin Disc Clutch Co. ..... *

Union Carbide & Carbon Corp. 71
United States Steel Corp. ..... *
United States Steel Products Co. ..... *

Veeder-Root, Inc. ..... *
Vickers, Inc. ..... *
Victor Electric Products, Inc. 76
Viking Pump Co. 12

Wagner Electric Corp. 72
Waldron, John, Corp. ..... *
Westinghouse Electric & Mfg. Co. ..... *
Whitney Chain & Mfg. Co., The ..... *
Wisconsin Motor Corp. ..... *
Worthington Pump & Machinery Corp. ..... *

*Advertisements appear in previous issues.

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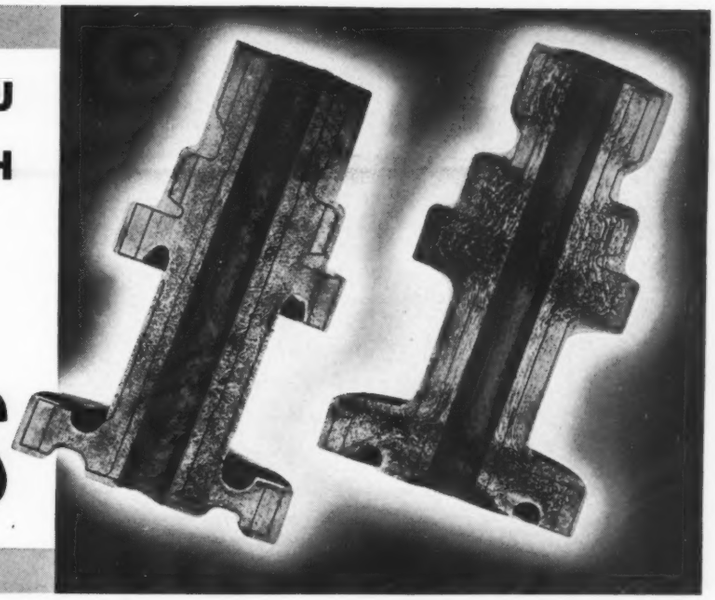

Here is the Proof

Modern metallurgy takes no chances. It proves its case in the laboratory, long before actual operation.

The macro-sections shown here are etched to the same degree, to show comparative metal structure. Lines show the finished machine size of this part — an automotive gear.

The cast steel gear, at left, shows *much* better structure throughout. Unlike its competitor on the right the cast steel gear shows no structural weakness parallel to, and near the base of the gear teeth, where greatest strength is needed.

Proved in the laboratory, the cast steel gear again proved itself in actual service, with less tooth wear, less breakage and longer life.

Steel Castings, for gears and other parts, will help you make improvements like this in your product. Talk it over with your steel foundry, or if you prefer, write for information to the Steel Founders' Society of America, who sponsor this advertisement. Address 920 Midland Bldg., Cleveland, Ohio.

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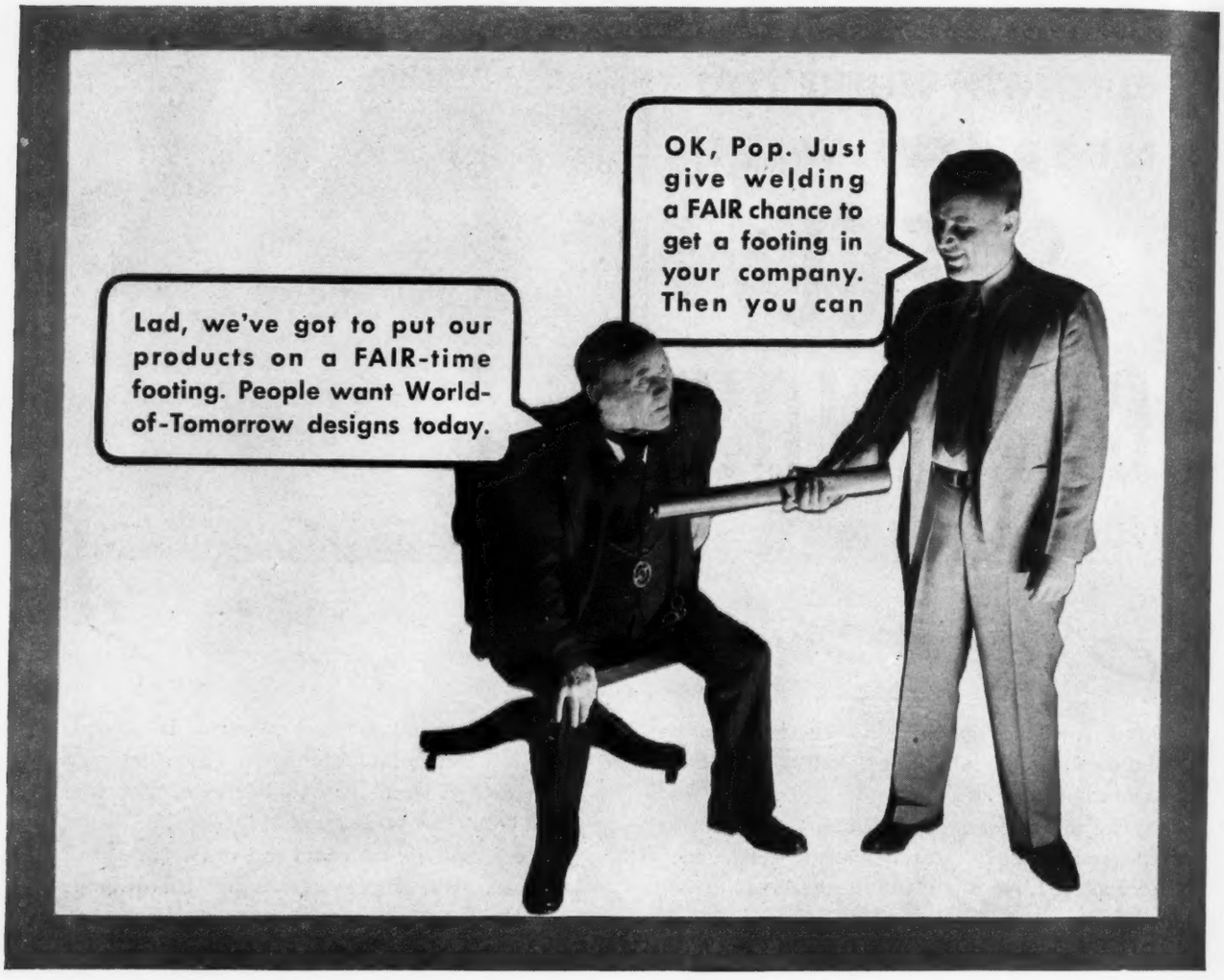
Lad, we've got to put our products on a FAIR-time footing. People want World-of-Tomorrow designs today.
OK, Pop. Just give welding a FAIR chance to get a footing in your company. Then you can

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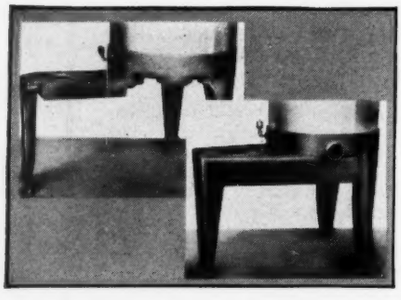

• A FAIR example is this stand, typical of bases and frames used on many machines. On the left we have the former construction—a collection of parts bolted together. On the right we have the design of today—a rigid unit of welded pressed steel, streamlined for eye appeal and sales.

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